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Vol. X. November 25, 1910 No. 1

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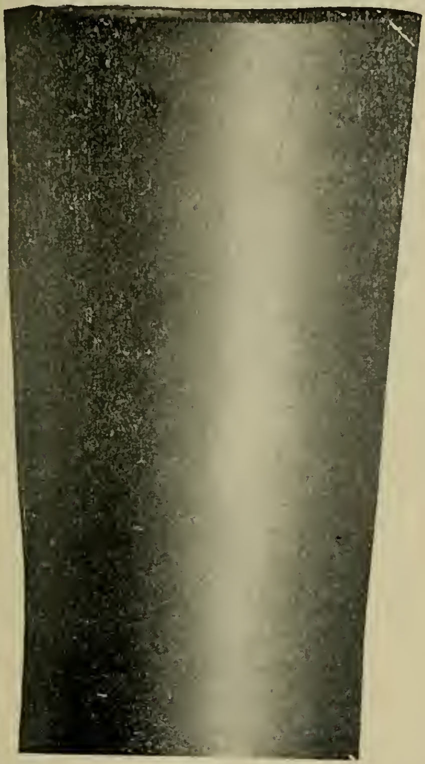

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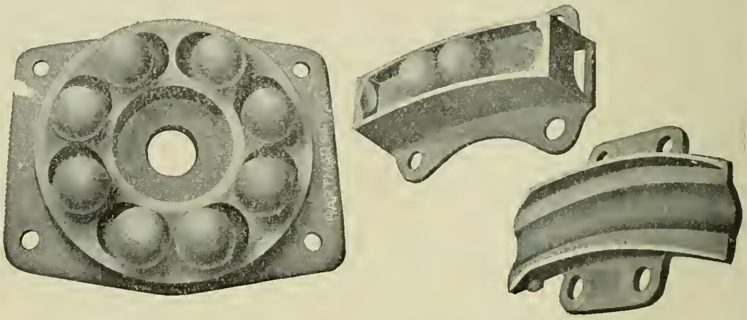

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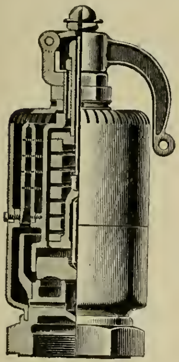

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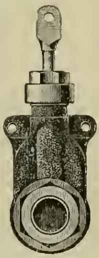

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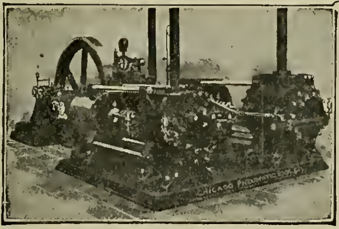

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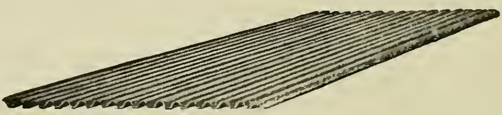

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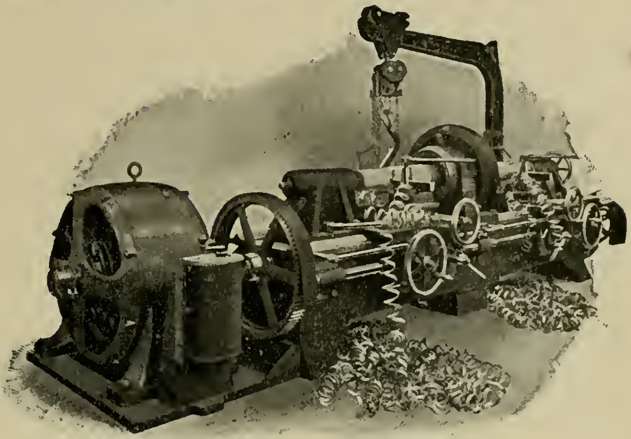

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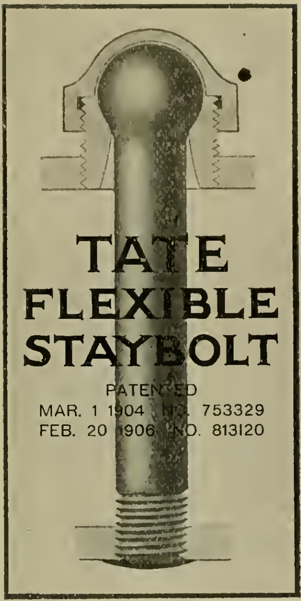

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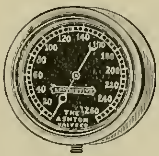

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INDEX—ADVERTISERS.

NAME	Page
American Brake Shoe & Foundry Co.	iii
American Locomotive Company.	viii
Ashton Valve Co	xi
Ball Chemical Co	ii
Brady Brass Co	Front Cover
Butler Drawbar Attachment Co	xviii
Chicago Pneumatic Tool Co	v
Clancy, J. R.	xvii
Cleveland City Forge & Iron Company	Front Cover
Crosby Steam Gage & Valve Co	v
Damascus Brake Beam Co	xvii
Dixon, Jos., Crucible Co	vi
Flannery Bolt Co	xi
Fort Pitt Malleable Iron Co	xii
Franklin Manufacturing Co	viii
Galena-Signal Oil Co	xii
Gold Car Heating & Lighting Co.	vi
Gould Coupler Co	ii
Homestead Valve Mfg. Co	iv
Hunt-Spiller Mfg. Corp	xi
Lawrenceville Bronze Co	xv
Lino Paint Co	Back Cover
Long, Chas. R. Jr. Co	iii
Magnus Metal Company	vi
Manning, Maxwell & Moore	iii
McConway & Torley Company	xv
Nathan Manufacturing Co	iv
National Car Wheel Co	iii
National Malleable Castings Co	vi
National Tube Co	i
Niles-Bement Pond Co	ix
Page Woven Wire Fence Co	Front Cover
Peerless Rubber Mfg. Co	xvii
Pittsburgh Coal Co	iv
Pittsburgh Equipment Co	Back Cover
Pittsburgh Testing Laboratory	Front Cover
Pressed Steel Car Co	xx
Railway Steel Spring Co	xvi
Safety Car Heating & Lighting Co.	xvi
Sipe, James B. & Co	Front Cover
Standard Coupler Co	xix
Standard Steel Car Co	xviii
Steel Car Forge Co	Front Cover
Suydam, M. B. Co	Back Cover
Union Spring & Mfg. Co	xiv
Union Steel Casting Co	xix
Ward Equipment Co	xix
Washington Coal & Coke Co	ix
Western Railway Equip. Co.	Front Cover
Westinghouse Air Brake Co	vii
Westinghouse Electric & Mfg. Co.	vii
Westinghouse Machine Co	vii
Wood, Guilford S.	Front Cover

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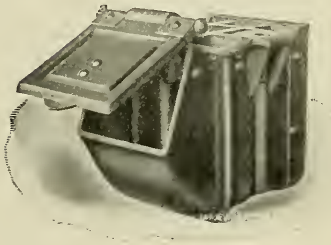

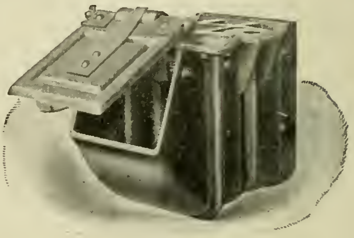

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Vol. X.
No. 1.

Pittsburgh, Pa., November 25, 1910.

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Published monthly, except June, July and August, by the Railway Club of Pittsburgh, C. W. Alleman, Secretary, General Offices P. & L. E. R. R., Pittsburgh, Pa.

Meetings held fourth Friday each month, except June, July and August.

PROCEEDINGS OF MEETING,
NOVEMBER 25th, 1910.

The meeting was called to order at the Fort Pitt Hotel, Pittsburgh, Pa., at 8:00 o'clock P. M., with President F. R. McFeatters in the chair.

The following gentlemen registered:

MEMBERS.

Alleman, C. W.
Amsbary, D. H.
Barth, John W .
Beatty, E. A.
Bennett, R. G.
Black, F. J.
Brandt, E. K.
Brown, L. M.
Chilcoat, H. E.
Clark, C. C.
Cline, W. A.
Conway, J. D.
Coulter, A. F.
Craig, E. A.
Crouch, A. W.
Deckman, E. J.
Drake, W. C.
Drayer, U. S.
Eichenberger, J. J.
Fettinger, H. O.
George, M. E.
Gies, Geo. E.
Gutierrez, S. J.
Guy, W. A.
Haas, Benjamin
Hardman, H. J.
Haring, Ellsworth
Howe, D. M.
Hudson, W. L.
Huyett, E. G.
Keyser, R. H.
Kinney, M. A.
Kinter, D. H.
Kirk, T. S.
Knight, E. A.
Knox, Wm. J.
Lehr, H. W.
Leonard, Jas., Jr.
Lewis, Jas. M.
Lindstrom, Chas. A.
Lobez, P. L.
Long, R. M.
Lowe, Wilfrid D.
Mackenzie, R. H.
Malloy, M. A.
Mason, F. N.
Mason, Stephen C.
Mensch, E. M.
Mitchell, A. G.
McDonnell, F. V.
McFeatters, F. R.
McKeen, J. W.
McNulty, F. M.
Noble, D. C.
Pechstein, Albert J. G.
Peacock, Wm.
Pfeil, John
Porter, H. V.
Postlethwaite, C. E.
Rabold, William E.
Redding, D. J.
Robinson, J. R.
Rupp, R. D.
Ryan, W. F.
Schoonover, W. H.
Smith, A. D.
Smith, M. A.
Smith, Russell
Stewart, S. R. B
Stucki, A.
Sullivan, W. H.
Taylor, H. G.
Tucker, J. L.
Way, L. A.
Wescoe, F. B.
White, F. L.
Williams, W. W.
Wood, Ralph C.

VISITORS.

Allen, Harvey,
Baldwin, G. C.
Clark, Homer L.
Conway, Scott M.

Cullen, J. C.
Dreyfus, E. D.
Edwards, Walter W.
Faris, J. M.
Fithian, E. J.
Gressitt, J. L.
Herrvey, Frank
Hebinder, A. H.
Hibbard, C. B.
Jenks, Charles D.
Knight, C. C.
Kunkle, H.
Lawrenz, E.
Mortland, W. G.
Morrison, D. P.
Ryder, G. E.
Smith, E. Rayson
Smith, Sion B.
Thomas, T. H.
Toomey, J. J.

The reading of the minutes of the last meeting was dispensed with, they being in the hands of the printer.

The Secretary read the following list of applications for membership:

Anthony, H. F., Telegraph Operator, P. R. R., 7219 Finance St., Homewood Station, Pittsburgh, Pa. Proposed by J. S. Fleck.

Baldwin, G. C., General Foreman, Lumber Dept., Pressed Steel Car Co., McKees Rocks, Pa. Proposed by Russell Smith.

Beswick, John, Asst. Road Foreman of Engines, P. R. R., 116 Main St., Johnstown, Pa. Proposed by O. C. Coho.

Briggs, Ira Otis, Train Dispatcher, Pittsburgh Division, P. R. R. Co., Union Station, Pittsburgh, Pa. Proposed by J. S. Fleck.

Bryant, C. W., Asst. Chief Clerk to Supt., B. & O. R. R., 170 Marsden St., Pittsburgh, Pa. Proposed by John J. Publow.

Cage, G. N., Asst. Road Foreman of Engines, B. & O. R. R., Rockwood, Pa. Proposed by A. W. Crouch.

Conley, Clark C., Train Dispatcher, Penna. R. R. Co., Union Station, Pittsburgh, Pa. Proposed by R. H. Mackenzie.

Conroy, L. W., Asst. Chief Inspector, Schoen Steel Wheel Works, McKees Rocks, Pa. Proposed by Frank J. Black.

Craig, E. M., Smoke Inspector, Penna. R. R. Co., 601 West Railroad Ave., Oakmont, Pa. Proposed by G. C. Walther.

Dennis, James G., Train Dispatcher, Penna. R. R. Co., Union Station, Pittsburgh, Pa. Proposed by R. H. Mackenzie.

Glass, H. M., Asst. Round House Foreman, Allegheny Valley Ry., Forty-eighth St., Pittsburgh, Pa. Proposed by A. Stucki.

Glassburn, S. G., Asst. Road Foreman of Engines, P. R. R. Co., 708 Sixth Ave., Altoona, Pa. Proposed by O. C. Coho.

Hamilton, William, Manager, Railway Dept., Billings-Chapin Co., Fort Pitt Hotel, Pittsburgh, Pa. Proposed by D. M. Howe.

Harriman, Henry A., Traffic Manager, Pittsburgh Provision & Packing Co., Herrs Island, Pittsburgh, Pa. Proposed by R. H. Mackenzie.

Helm, E. E., Asst. Train Master, P. R. R. Co., P. O. Box 951, California, Pa. Proposed by M. A. Malloy.

Hoffstot, H. P., Asst. to General Manager, Pressed Steel Car Co., Farmers Bank Bldg., Pittsburgh, Pa. Proposed by Chas. A. Lindstrom.

Kurzhals, Chas. L., Transfer Foreman, Penna. Co., 409 Adams St., Rochester, Pa. Proposed by F. B. Wescoe.

Menaugh, Norman S., Train Dispatcher, Pittsburgh Division, P. R. R. Co., 220 South Highland Ave., Pittsburgh, Pa. Proposed by R. H. Mackenzie.

Morris, Jack M., Extra Train Dispatcher, Penna. R. R. Co., 7424 Idlewild St., Pittsburgh, Pa. Proposed by R. H. Mackenzie.

Murphy, W. C., Train Dispatcher, P. R. R. Co., 2324 Woodstock Ave., Swissvale, Pa. Proposed by R. H. Mackenzie.

Neylon, J. F., General Manager Wm. Harris & Sons Co., 709 Belmont St., North Side, Pittsburgh, Pa. Proposed by A. Stucki.

Orner, Milton T. S., Chief Clerk to District Freight Solicitor, Penna. Co., Oliver Bldg., Pittsburgh, Pa. Proposed by R. H. Mackenzie.

Peters, W. P., Lieutenant of Police, P. R. R. Co., P. O. Box 492, Freeport, Pa. Proposed by G. C. Walther.

Root, E. E., Foreman, P. R. R. Co., 222 Market St., Brownsville, Pa. Proposed by M. A. Malloy.

Routh, Chas. M., Chief Draftsman, Schoen Steel Wheel Works, 814 Wager St., Munhall, Pa. Proposed by Frank J. Black.

Sargeant, W. A., General Manager, Consolidated Lamp & Glass Co., 1630 Ridge Ave., Coraopolis, Pa. Proposed by F. H. Stark.

Schneider, G. C., Asst. Engine House Foreman, Penna. R. R. Co., Derry, Pa. Proposed by C. J. Halliwell.

Snitehurst, Jas. G., Engine House Foreman, Penna. R. R. Co., P. O. Box 35, Youngwood, Pa. Proposed by O. C. Coho.

Snow, Walter T., Manager of Sales, Reno Bros. Paint Co., 526 Grimes St., Sewickley, Pa. Proposed by D. M. Howe.

Snyder, K. G., Purchasing Agent, Western Allegheny R. R. Co., Diamond Bank Bldg., Pittsburgh, Pa. Proposed by E. J. Deckman.

PRESIDENT: When these names have been favorably passed upon by the Executive Committee the gentlemen will become members.

If there is no further business to come before the meeting we will proceed to the paper of the evening, on "Some Pertinent Features Relating to Gas Power," by Mr. E. D. Dreyfus, of the Westinghouse Machine Company.

Some Pertinent Features Relating to Gas Power.

BY MR. E. D. DREYFUS, COMMERCIAL ENGINEER, WESTINGHOUSE MACHINE CO., PITTSBURGH.

During the fifteen years of commercial use of the gas engine in this country, abundant experience has been furnished, from which may be deduced two features of importance, viz:

(a) The distinct fields of usefulness may be determined definitely under any conditions, and in general may be very well defined. Contrary to the frequent implication that gas is a direct competitor of steam power, or other source of energy supply, there are unmistakable regions where the gas plant is unqualifiedly superior; and on the other hand, places where it would be an economic disadvantage. Evidently there exists a temporary line of division, or equality, (but occasionally encountered), leaving the decision to rest upon probable changes in industrial or operating conditions.

(b) Gas power machinery is less responsive to the ingenious fancy of the designer than the other well-known types of station equipment. Not that it is in the least degree less reliable, as automobile work evinces, but the pre-requisite characteristics of satisfactory operation and continuity of service may be satisfied only by a simple and effective design, from which but small deviation is feasible.

More than from any other cause, the disregard of these factors has evidently been more harmful to the gas engine art in prejudicing its use where otherwise it would have proved a judicious selection. Notwithstanding this, the industry has materially prospered, and owing to its inherent high efficiency in the conversion of latent thermal energy into useful mechanical power, it will increasingly continue to fasten its attention upon the engineering profession and commercial world. Uninterrupted progress may be assured in the forestalling of dissatisfaction, and for the benefit of this branch of engineering, the requirement and intrinsic value are frankly discussed.

A division* in obtainable gases for engine operation may be thus made:

(1) *Natural Gas*—Existing principally in Western Pennsylvania, Western New York, West Virginia, Ohio, Kentucky, Kansas and Louisiana districts. It is virtually an ideal quality of gas, possessing high heat value, free from suspended impurities and absence of any great percentage of highly inflammable constituents (hydrogen chiefly).

(2) *By-Product Gas*—Obtaining mainly in the metallurgical and mining industries, as blast furnace and coke oven gas, and in oil refineries as distillate. Both so-termed metallurgical gases are, in their crude form, accompanied by objectionable impuri-

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*Graphically illustrated in the appended chart, Fig. 13.

ties—entrained ore dust in the former, and oily vapors, lampblack and sulphurous compounds in the latter, which must be removed to a reasonable degree by cleaning and scrubbing apparatus before delivery to the engine.

(3) *Artificial or Town Gas*—As several different fuels and processes are employed in the manufacture of combustible gases, there is consequently a variety of supply successfully used in the gas engine, and their abstract importance follows:

(a) Illuminating, or coal gas, produced in benches or retorts by destructive distillation, is available in practically all localities in the city limits. It is of high heat value, and of necessity a fairly clean gas. There is a high percentage of hydrogen present which compels the use of comparatively low compression to prevent preignition. Owing to the enrichment essential for illuminating purposes, with the added expense of distribution, the cost of this gas to the consumer ordinarily confines its use for power purposes to very special cases.

(b) City gas, either made from the partial oxidation of coal and carburetted, or from crude oil, possesses the same limitations as far as the gas engine is concerned. Bluewater of somewhat lower heat value and cost, is also less satisfactory and economical than the familiar producer gas power.

(a) *Producer Gas*—The producer gas from both anthracite and bituminous grades of coal, presents the logical solution for the use of the gas engine in absence of by-product, or natural gas, at consistently low prices.

(b) Oil gas producers for power purposes have not yet attained a sufficient degree of development to warrant extended use. But where crude oil is the predominating fuel supply, some installations have been made with fair success.

Oil and Gasoline—Only with the unrefined mineral oils is the internal combustion engine able to show true economy. Due to operating and constructive difficulties in the larger sizes, the best possibilities of the oil engine has not yet been realized in actual practice, in this country, at least.

Efficiencies—The foremost characteristics of the gas engine lies in its uniformly high thermal efficiency over all ranges of sizes. Such small variation as may be found are trifling. This virtue does not apply to steam motors, either reciprocating engines or turbines, and hence the greatest utility of the gas engine, barring by-product or natural gas supply, will occur in the smaller operations.

For an illustration of this phase, Fig. 1 is presented, which shows conservative heat consumptions in B. T. U. per kw. hr. output for turbines ranging from 500 to 10,000 kw. inclusive,

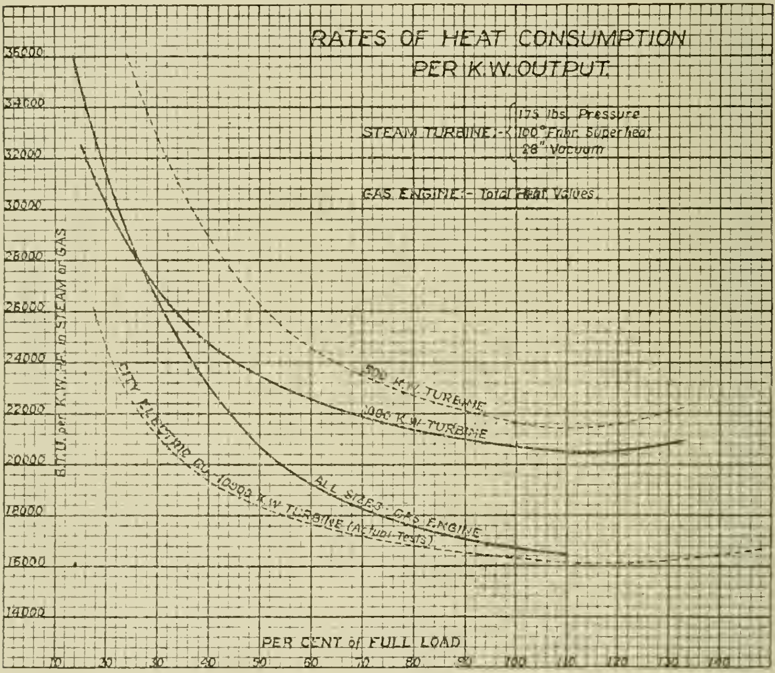

Fig. 1. Characteristic Efficiency Curves, Turbines and Gas Engines.

and typical gas engine curves which represent all sizes. The latter is expressed on the basis of total heat supply, assuming a gas quality containing a high hydrogen content (lowering the effective value, say 8%), preferably to place the two types of units on the same plane. Thus it is evident that as the larger capacities are approached, the disparity between gas and steam motors steadily vanishes, either plant consuming approximately 2 lbs. of coal per kw. hr. Conversely, with a decrease in size of the plant, there is a wider gap between the two types of equipments, where the gas plant will continue to develop a killowatt hour on two pounds of coal, while the steam station may use 8 to 12 pounds or more. Fig. 2 represents the typical results of test on a small producer gas power plant.

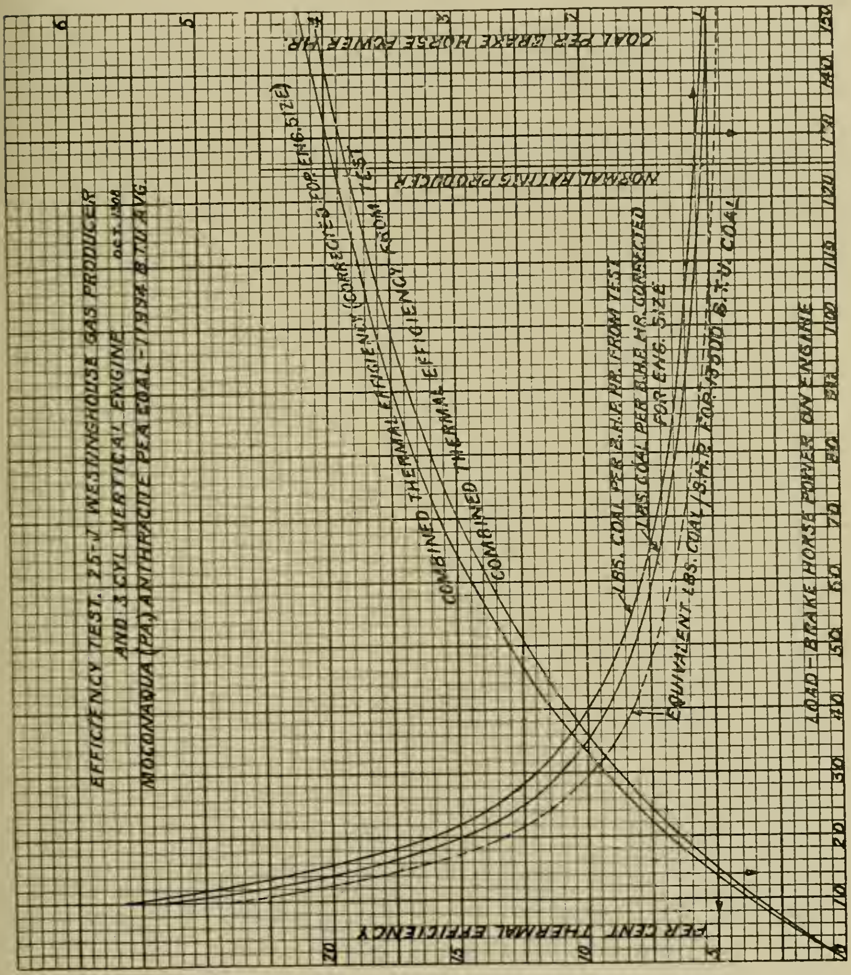

Fig. 2. Average Economy of Gas Engine and Producer.

On the other hand, it is of interest to note the similarity of the boiler and gas producer efficiencies. Either class of generator may be operated with efficiencies as high as 75%, as a very general average, and these efficiencies reduce only a small corresponding amount in both apparatus over their entire working range.

Now, here the supply is available in the form of natural or by-product gas; it is plain the gas engine reaps the advantage of dispensing with the producer losses and expense. The corresponding boiler in a steam plant would, of course, have to be continued.

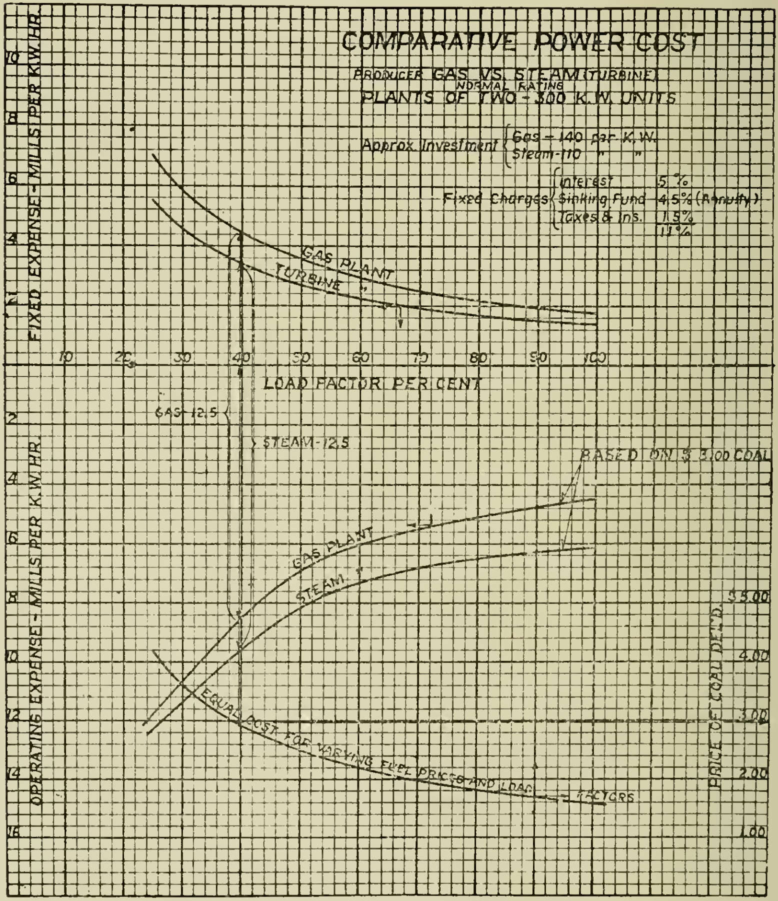

Fig. 3. Cost of Power—Gas vs. Steam.
(Fixed charges arbitrarily assumed equal.)

Economic Value—The impression that gas power invariably implies a lower cost of generation is constantly being dispelled through the critical analysis of the elements of power cost. Fuel is manifestly only a fraction of the entire expense. Customarily a division is made between (a) capital charges*, embodying interest, depreciation, taxes and insurance, occasioned by investment, and (b) the running cost, which includes fuel, labor, oil, waste, water, supplies and up-keep. To exhibit the importance of the cost constituents Fig. 3 is given, which is based on plants consisting of two units and burning $3.00 coal, delivered.

The composite cost of a gas plant laid down exceeds that of a high-grade steam station by approximately 30%. Such difference is quite normal in view of the character of working in the two plants. The engines must be rigged to withstand combustion pressures reaching 450 lbs. Corresponding temperatures may rise to 3000 deg. Fah., and, therefore, effective cooling of the exposed surfaces must be provided. In a turbine the conditions are far more moderate—pressures 150 to 200 lbs. per sq. in. and temperatures in the neighborhood of 300 to 500 degrees Fah. Turbines are operated at such relatively high speeds that very efficient use is made of the material employed.

Regarding the greater forces necessary to control in the gas engine, the designer has met the requirements by evolving a substantial design, as typified by the representative type herein shown. And this apparently holds over a large variation in capacity. Consequently, the greater inherent fixed expense will accordingly detract to an extent from its high economy in the use of fuel.

Labor in small gas and steam plants will not differ seriously, but the simple turbine, with its minimum of parts, places a severe handicap on the gas engine when high powers are contemplated, contributing another reason for the barrier against the use of large gas engines for central stations burning coal as fuel.

Having the size and cost of the plant, together with the schedule of operating labor and supplies arranged, the decision hinges upon the probable load factor, and also the price of fuel where it may be subject to variation. It is an obvious fact that low load factors prejudice the use of expensive installations, notwithstanding their superior efficiency.

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*"Supercession in the art disregarded being a quantity of such wide interpretation."

Fortunately for the gas plant, the embarrassment of low load factor conditions may be partially ameliorated by the use of a simple low pressure turbine in conjunction with a heat storage system supplied by the waste heat of the engine and operated to sustain the peak of the load.

Previously power generation has mainly been reckoned with as applying to central distribution. But in the machine shop, factory and related industries, the power house is surrounded by another demand, viz., heat supply, especially above latitude 37°. The heating requirement has very often been improperly allowed to discount the intrinsic value of the gas plant for the reason that the waste heat energy is not concentrated in the same convenient vehicle for transmission to the point of consumption, as obtains with the non-condensing engine or turbine.

More recently, consideration of the waste heat from gas engines has been revised, and exhaust heaters have been devised which render available in the form of steam 70% of the heat of the exhaust. While this quantity represents only two pounds of steam per brake horse power developed, it will evidently prove sufficient where the ratio of power to steam demand is low. Where the "*power steam factor*," i. e., the ratio of the pounds of steam required to the brake horse power demand is known, an adequate choice of prime mover may be vouchsafed, as the following table may illustrate:

	Based on B. h. p.
Simple automatic engine	40
Small steam turbine	30
Single cylinder Corliss engine	28
Corliss non-condensing compound engine	22
Automatic bleeder turbine	20
Complete expansion turbine (bleeding 25% from receiver)	6
Gas engine (waste heat—jacket and exhaust—used in hot water system)	5
Gas engine only, exhaust applied to steaming	2

Since the maximum heating demanded in industrial work occurs during only the minor part of the year, supplementary heating apparatus may well be provided to ensure the highest degree of economy the remainder of the time.

Natural gas, though an excellent fuel for the gas engine, may only be regarded as available where the cost does not exceed an equivalent power value generated in a producer for a fixed coal price (delivered). This is clearly shown in Fig. 4, where the diagonal lines indicates the equated value of gas and coal under the assumption outlined therein.

Types—More is undoubtedly known of the principles and cycles of operation employed in the gas engine than of the working problems involved. Therefore, it will suffice to merely touch upon the underlying theory and methods used in practice. Quite distinct from the common steam engine or turbine, the power charge enters the cylinder as latent energy void of any static or dynamic force. It must be compressed a number of atmospheres before it can be burned efficiently. Then combustion takes place, producing a power stroke, followed by a stroke discharging the spent gases from the cylinder. One complete revolution is thus devoted to the preparation of the power stroke, and consequently

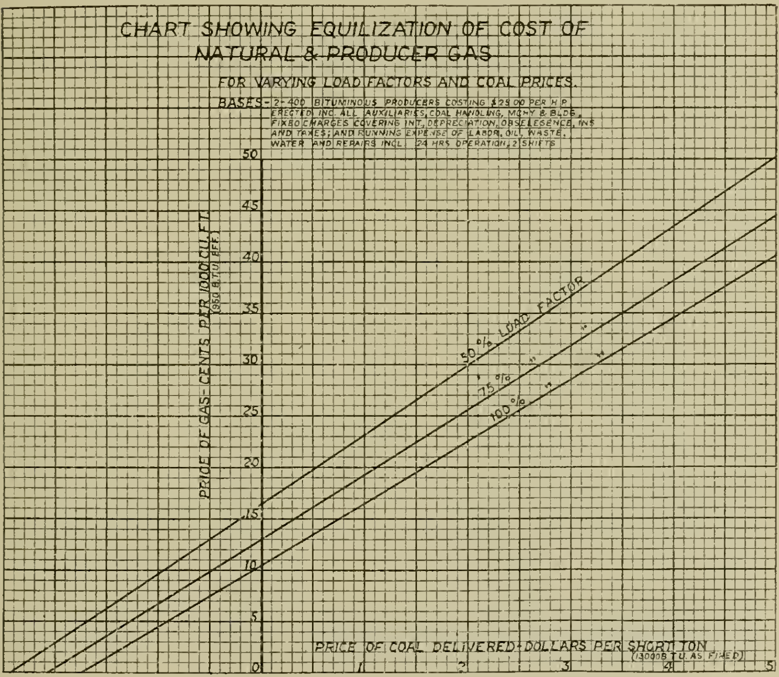
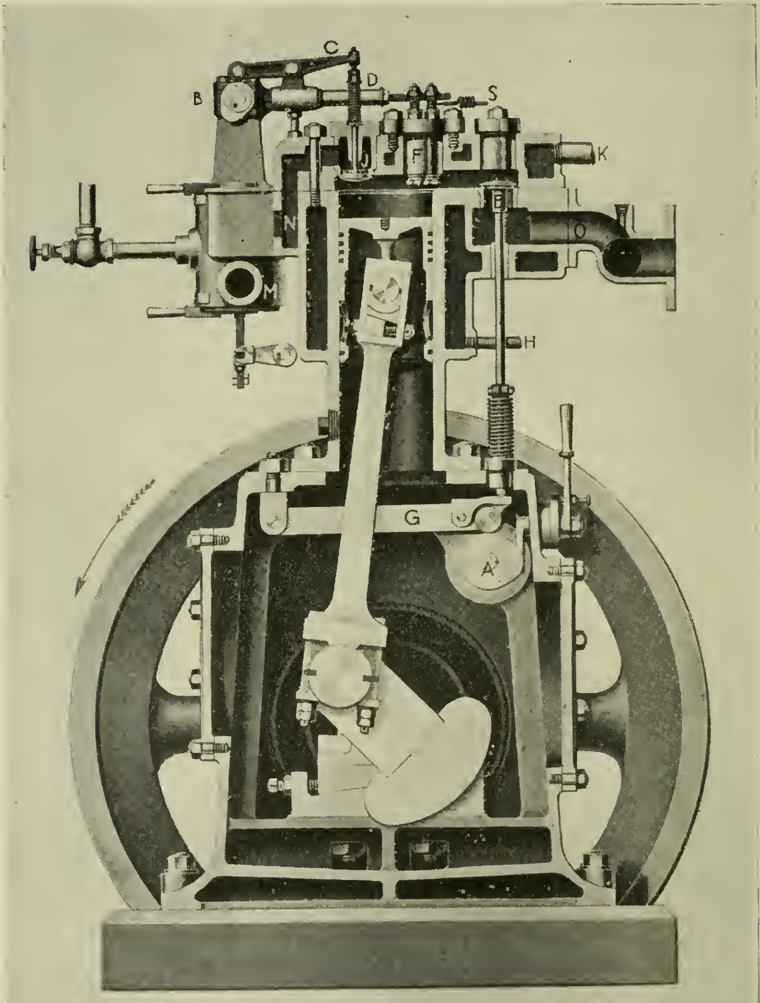


Fig. 4. Evaluation of Natural Gas.



Cross Section through Cylinder

Fig. 5. Section of a Typical Vertical Gas Engine.

an impulse is only exerted upon the crank every second revolution in a single-acting cylinder, and one in each revolution for a double-acting cylinder. This constitutes the four cycle system. Two cycle engines are also in commercial use, and they purpose to do away with the idle stroke, which is achieved by an auxiliary pump serving a dual function of scavenging the cylinder of foul gases at the end of expansion and delivering a compressed charge of mixture preceding the successive stroke. In this arrangement two power strokes per revolution is attained. However, the practical application is attended with operating difficulties, viz., loss of unburned fuel in scavenging, low mechanical efficiency (introduced by auxiliary pumps) and frequent renewals and replacement of parts. The four cycle engine is, therefore, today the universal type of gas motor.

Vertical and Horizontal Frames—In smaller sizes the problem resolves itself, in a sense, into a matter of individual preference. But this is not strictly true. Small units are preferably made single-acting to avoid the wear and deterioration of the piston rod and gland packing, subject to the action of the gases. Minimum wear on cylinder and simplicity of cylinder and piston (trunk type), are evident in the vertical type. (See Fig. 5.)

In the larger sizes the vertical cylinder would become cumbersome and less accessible, leading to expansion and vibrating troubles. The horizontal type has become common practice in large powers, with "floating" water-cooled pistons suspended on the main, intermediate and rear cross-heads (See Fig. 6). Excepting some builds of small engines, all horizontals have tandem cylinders, providing two impulses every revolution.

Structural Details—The fact has already been noted that high pressures and temperatures are encountered in the gas engine. A construction is demanded that introduces no abnormal casting, temperatures or working strains, particularly in the cylinders, heads and pistons.

Outside of the cylinders and valve gear the various parts resemble steam engine practice, but are far heavier, due to the greater magnitude of the impulses.

It is a source of considerable satisfaction to observe that the vertical design (Fig. 5) has necessitated no changes in general construction, and but trifling modifications to perfect the details—such as the piston rings, mixing valve and similar features, since the first engines were removed from the experimental stage over fifteen years ago.

The more rapid development of the horizontal type and the accompanying large powers, preclude establishing the correctness and accuracy of the design other than in the field. This unavoidably created an expensive school of experience, incidentally consuming a vast amount of patience, both of the user and the manufacturer—not, however, without bearing fruitful results, in which a well-developed and rugged design has emerged from the study and analysis of the troubles of the early types and their details. Proper design of gas engine cylinders and pistons, while now absolutely practicable, are plainly vital. A parallel epoch of gas engine history, recited by a German contemporary*, in the

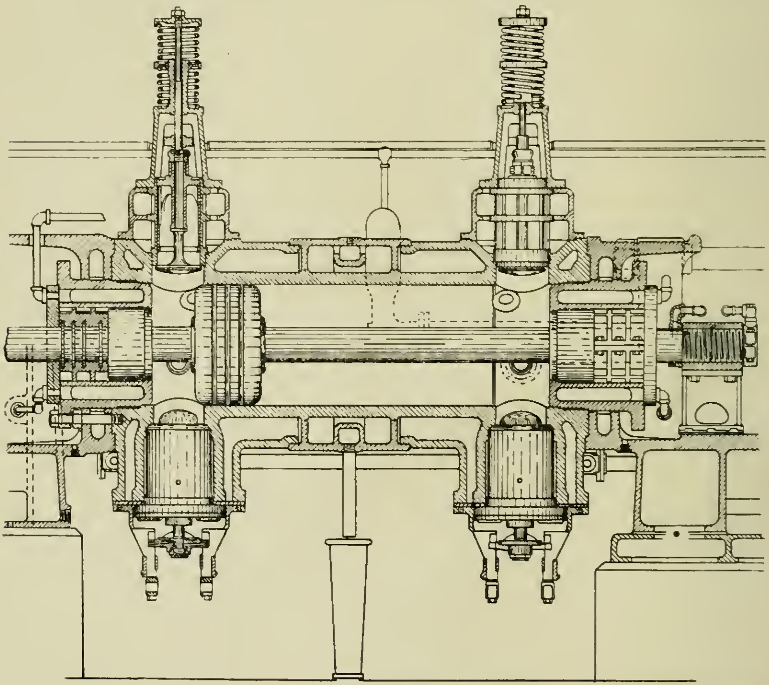


Fig. 6. Detail Section of a Modern Horizontal Gas Engine Cylinder.

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*Herr R. Drawe, of the Saarbrucken Machine Shops, Saarbrucken, Germany.

Steel and Iron Journal (February, 1910.) will force the attention of the power engineer to the value of rational designs. The article appeared in substance as follows:

"The single-piece cylinder type, shown in Fig. 7 still used by some but abandoned by the majority of builders, we have never given serious consideration, primarily for the following reasons:

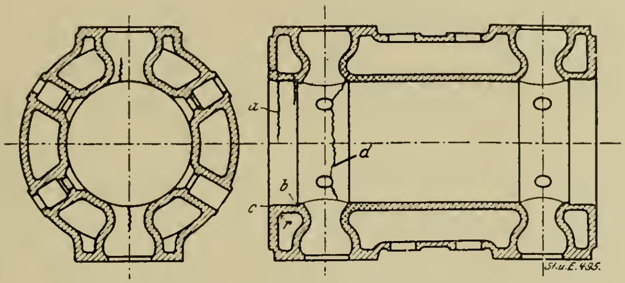

Fig. 7. One-Piece Cylinder Construction.

"(a) Difficulty of securing a close-grained, uniformly dense casting.

"(b) Existence of excessive initial casting strains, due to shrinkage difference between inner and outer walls.

"Moreover, the necessity of casting the outer walls in compression and the inner wall in tension, to counteract operating stresses, introduces an extremely uncertain factor, owing to the practical impossibility of properly gauging these stresses.

"The prevalence of cylinder-cracking, shown at (d), Fig. 7, can, therefore, be directly attributed to the involved design of the one-piece structure and the frequent breakage that occurs when the engines are shut down, are probably due to the unequal cooling of the parts and the uneven increase of the casting strains designed to be neutralized in operation.

"Careful tests made in Germany for the determination of the temperature different of inner and outer walls, have found this quantity to be in the neighborhood of 75° Centigrade (167° Fahrenheit), producing stresses many times in excess of those due to the explosion pressure alone.

"Cylinder flanges, if not correctly designed, are a prolific cause of accidents. With the form shown in Fig. 7, the high-bending stresses introduced when the cylinder head nuts are drawn up, frequently cause cracking at (a). This has been obviated in our cylinder and in many German makes, by enlarging the radius (r), establishing more effective resistance to the bending moment.

"The existence of casting strains in the double-walled cylinder will inevitably produce fatigue of material and consequent failure. The difficulty has led to the evolution of the two-piece cylinder with removable jacket, as shown in Fig. 8. By parting the cylinder circumferentially, it has been possible to secure a casting of maximum uniform density and one in which all casting and cooling strains are practically eliminated.

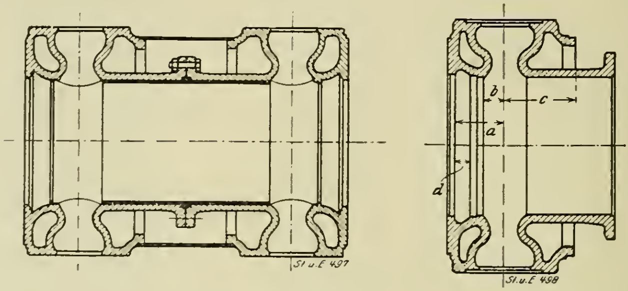

Fig. 8. Two-Piece Cylinder Structure with Liner and Separate Jacket Band.

"The presence of the bushing further acts to keep the two parts in perfect alignment and to effectively exclude any water that might find its way through the joint.

"German manufacturers have frequently essayed the four-piece construction (Fig. 9), illustrating a modification of the original Deutz cylinder. These attempts have been, for the most part, unsuccessful, the inherent advantages lying in the location of joints (b) and (c) at the point of maximum explosion pressure and temperature, obviously introducing dangerous possibilities of leakage between cylinder and jackets. Moreover, it is evident that erection difficulties are considerably increased through the inaccessibility of the inner flange bolts (a).

"The type of piston construction shown in Fig. 10 is, generally speaking, universal in character, individual makes varying only in minor details. Experience has indicated that it is more

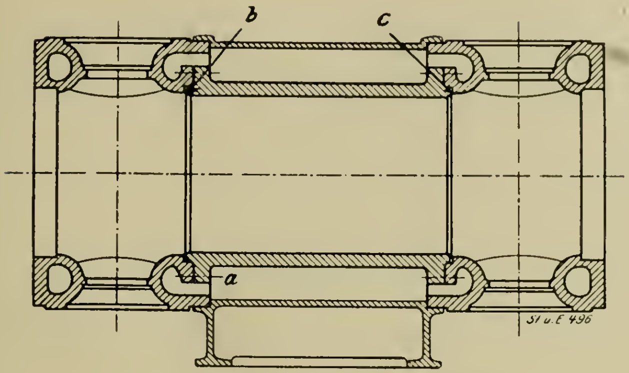

Fig. 9. Built-Up Four-Piece Cylinder.

desirable to have a short piston nut bearing at (d) Fig. 10, thus placing the entire hub under mechanical compression. With the bearing surface at (e), the tension and bending stresses occurring when the nut is drawn up, frequently occasion failure at (b) and (c), as shown.

"The split hub scheme, illustrated in Fig. 11 has been used with indifferent success in Germany, as an expedient to obtain initial compression in the hub. The method being rather a tedious one, and at best uncertain, it has never been generally adopted. The practice of ribbing the piston walls, still observed in some constructions, is not to be recommended, the unequal ex-

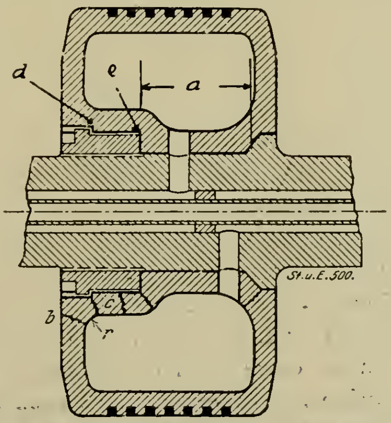

Fig. 10. Fractured Hub From Combined Tension and Compression Strains.

pansion of the relatively cool ribs and hot walls serving to stress the latter to a far greater extent than in the unbraced piston."

To the prospective user of gas power the knowledge of these troubles will not discourage, but will inspire confidence with the evidence of the discovery and removal of the evils in the first engines. It should, however, cause him to be chary of any appreciable departure from the proven design. Other ramifications in the engineering art—locomotives, stationary steam engines and turbines likewise—have invariably weathered the trials of the development stage. Fig. 6 practically coincides with Herr Drawe's conclusion, omitting the separation of the cylinder at the center, which is allowable in small frames to which the illustration applies. This feature is, however, necessary in large cylinders.

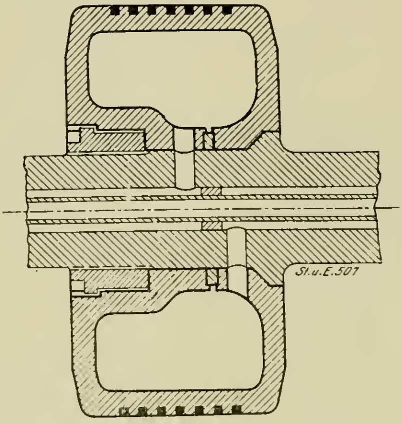

Fig. 11. Piston Design for Initial Compression in Hub. Successful Construction Difficult.

The cylinders are supported through the main frame and distance piece, and thereby relieved of any external load—another important count. Inlet and exhaust valves are located at each combustion chamber, diametrically opposite, allowing the greatest latitude for scavenging, avoiding the dilution of the incoming charge. The wide separation of the two valves leaves the incoming charge unaffected by the heated region surrounding the exhaust valve. Thus the capacity of the engine will not be diminished. Unpermissable length would be entailed to essay the remaining details, which would only serve to emphasize the degree of skill and workmanship necessarily centered about a dependable

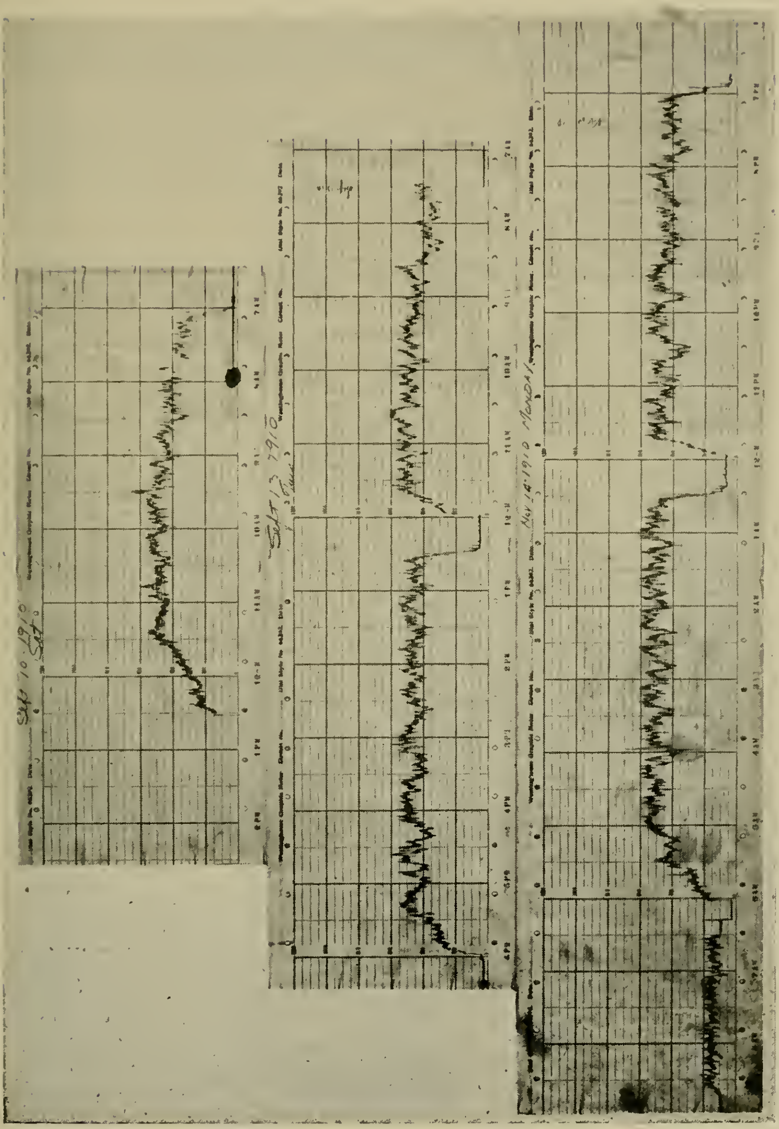

Fig. 12. Recording Graphic Charts showing varying load, served by a 750 B. H. P. Gas Engine, unit provider of uniform voltage regulation. Standard Underground Cable Co., Perth Amboy, N. J.

design. Production in the shop carries fully as great a responsibility, and the required standard of shop efficiency has been acquired only through extensive experience in this branch of the work.

Regulation—Of the three methods, "hit-and-miss," "constant quality and variable quantity" and "variable quality and constant quantity," which have been used commercially, the second principle only has satisfied the vigorous demands of heavy service. A large number of engines have been equipped with quality governing, but this arrangement is giving place to the more stable and simple quality regulation.

Again, to ensure the requisite degree of cyclical regularity, the mixture must be controlled directly adjacent to, or above the combustion chamber, as shown in Fig. 6, to avoid any store of mixture between the governor admission and the inlet valve. The reasons are obvious that the lag before the governor could respond to the load, would not be tolerated in important service, and, moreover, backfiring troubles may be seriously augmented.

The modern valve gear (Fig. 6) under test on 60-cycle work, solid coupled engines, operating in parallel at the Union Switch & Signal Company, maintained a mean angular deviation, with full-load thrown on and off, of 1.95 electrical degrees. Fig. 12 shows the characteristic load supplied by a 750 b. h. p. gas engine at the Perth Amboy plant of the Standard Underground Cable Company, exhibiting the sensitiveness of the governing system to the sudden and repeated changes in demand, and simultaneously providing good voltage regulation.

The Producer—In view of the limited space admissible in a general paper, this important phase of the gas power may only be broadly summarized. The foremost considerations resolve themselves into—

(1) Suction and pressure types.

(2) Dry or water-sealed bottom.

(3) In gasifying bituminous fuels, the method of fixation into a permanent gas or effective removal of the heavy hydrocarbons and oily compounds.

When the operation of the pressure producer plant with its disagreeable surrounding atmosphere, is understood, the extended use of the suction type is explained. Moreover, better control and more even oxidation throughout the fuel bed obtains. Possibly in occasional metallurgical fuel plants, these objections may be excepted.

Continuity of operation is best obtained in the use of water-sealed ash pits where ash and clinker may be withdrawn from the producer with least interference with the fire or reaction zones.

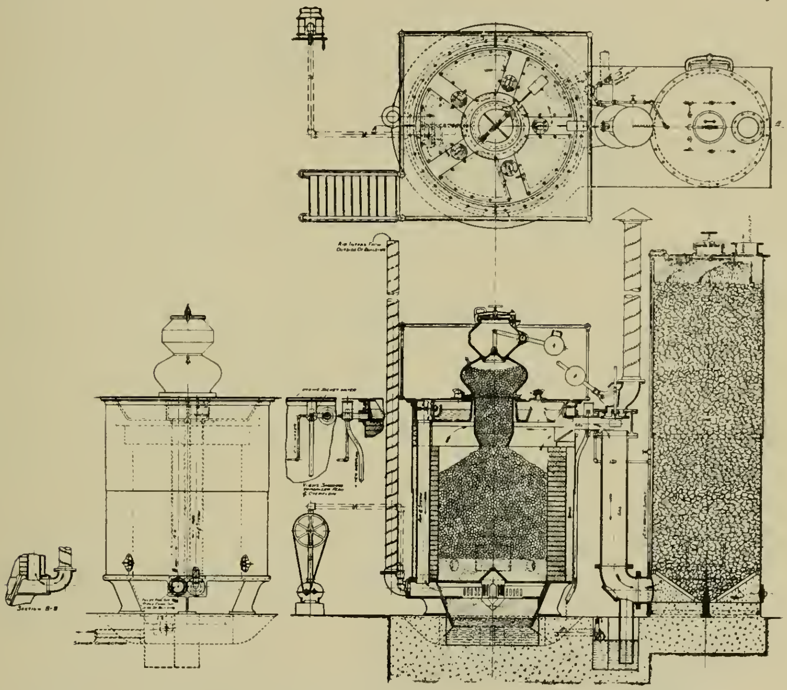

Fig. 13. Detail of Anthracite Gas Producer and Auxiliaries.

For the average power plant, gasifying a high volatile bituminous coal, a design is demanded which will, without intermittent operation or the making of burdensome tarry by-products, deliver a good quality of clean gas to the engines.* Types of construction which have in actual operation, achieved the desiderata, are shown in Figs. 13 and 14, for anthracite and bitumin-

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*See paper by F. E. Bulmahn on "A Bituminous Gas Producer," Engineer's Society of Western Pennsylvania, January, 1910, Proceedings.

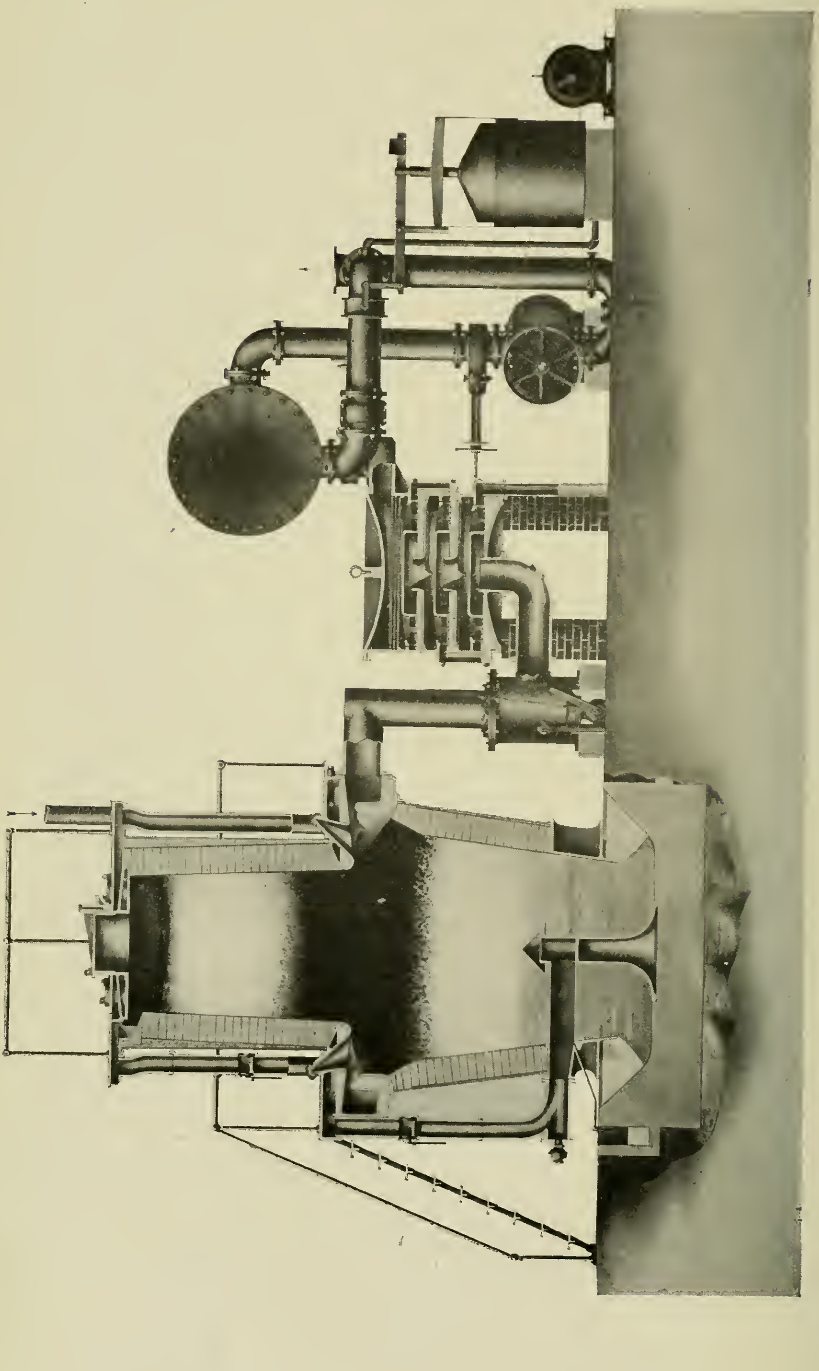


Fig. 14. Arrangement of Double Zone Bituminous Producer Plant.

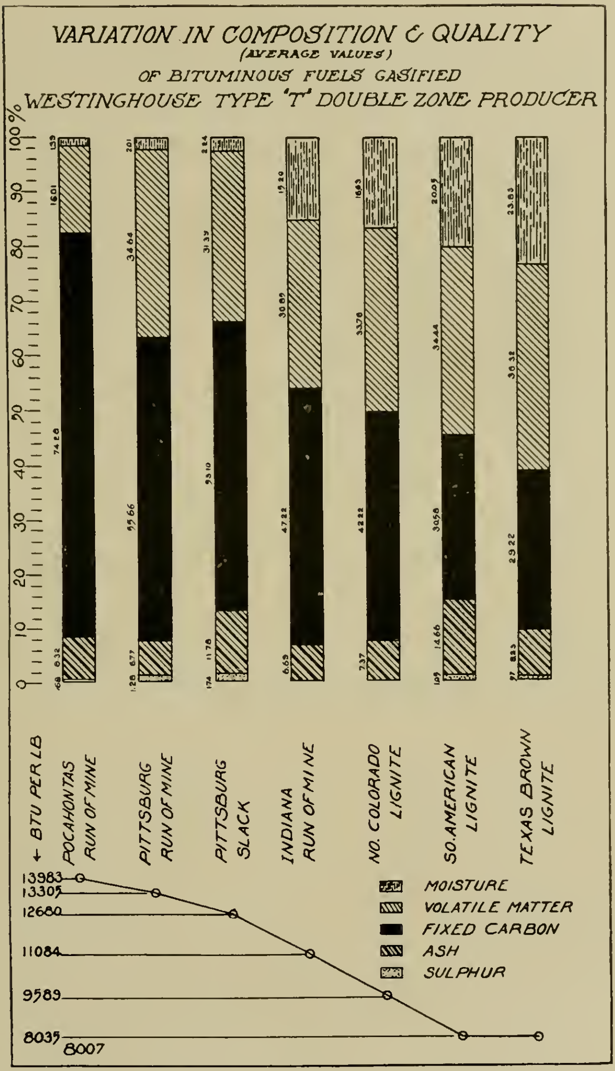
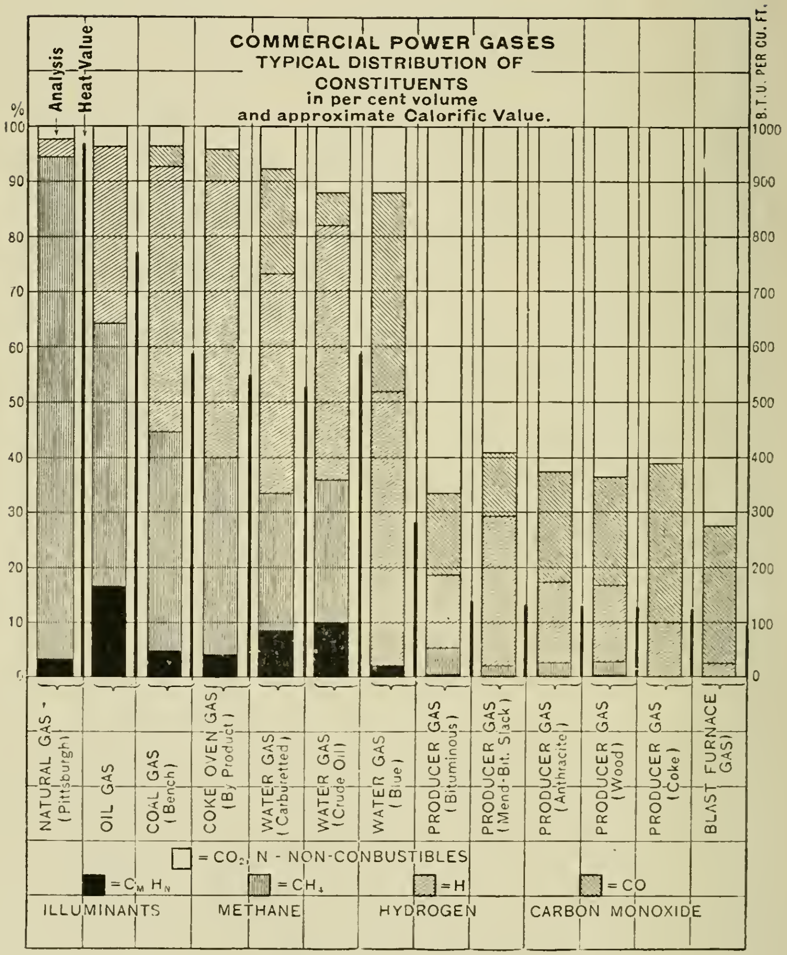


Fig. 15. Wide Variation in Fuel Quality Successfully Used in the Double Zone Producer Described.



Relative Value of Commercial Power Gases

Fig. 16. Average Heat Value and Analysis of Various Commercial Gases.

ous grades, respectively. Coal chart (Fig. 15) is instructive in showing the wide range of high volatile fuels successfully used in the latter type.

Maintenance—The present statistics, which may be taken as reliable in the data available, indicate very definitely that maintenance and repair expense of moderate size and well-designed gas power plants, is virtually on a parity with a high-grade steam turbine station. That this assertion is reasonable, manifests itself in the fact that the greater cost of cleaning and readjustment of boiler and condenser tubes above the negligible up-keep of the producer, largely counteracts the increased cost of "conditioning" the gas engine above that of the turbine. Hence the fixed charges were arbitrarily assumed equal in Fig. 3.

The real difference of opelessence or supercession in heat is more or less intangible at present, and consequently no distinction has been made in order to avoid complication.

Results—As an example of the operating efficiency, the following monthly record of a 550 b. h. p. gas power plant is presented:

550 H. P. GAS POWER PLANT.

Monthly Record of Operating Costs, December, 1909.
Unit Load Factor 89.3% : Investment Loading Factor, 67%.

PRODUCER ROOM—	Cents per kw. hour.
Fuel	0.202
Operating labor	0.120
Repairs:	
Labor	0.008
Material	0.000
Water	0.030
Auxiliary power	0.050
Fixed expense at 15% on investment	0.127
ENGINE ROOM—	
Operating labor	0.036
Repairs:	
Labor	0.050
Material	0.002

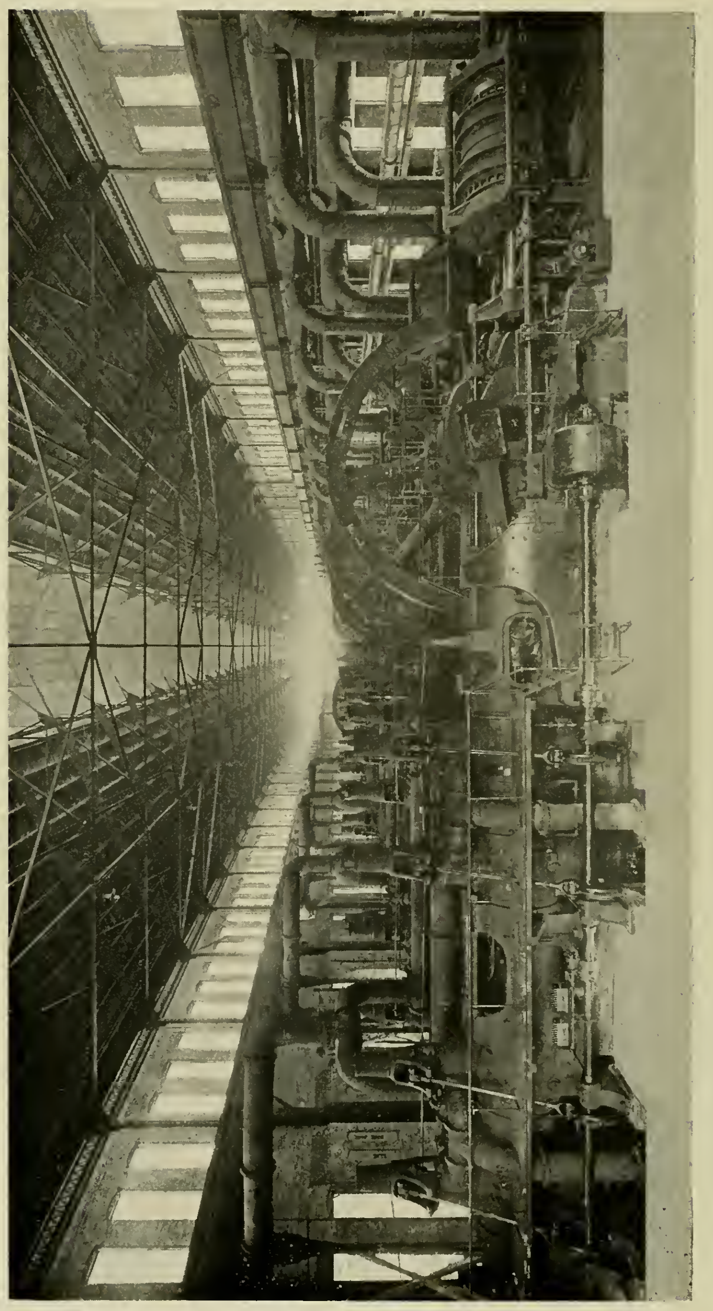


Fig. 17. Blast Furnace, Gas Driven Blowing Engines, Gary, Indiana.

Oil waste	0.010
Water	0.024
Fixed expense at 15% on investment	0.254
Total	0.913

Here we have a cost of current of less than one cent per kw. hr., which is really a remarkable attainment, considering the size of the plant, and the percentage investment charges imposed, excluding maintenance.

Installations—Gas power in this country today is estimated to represent an aggregate capacity of over 475,484 horse power, involving the following types in the order of their approximate importance:*

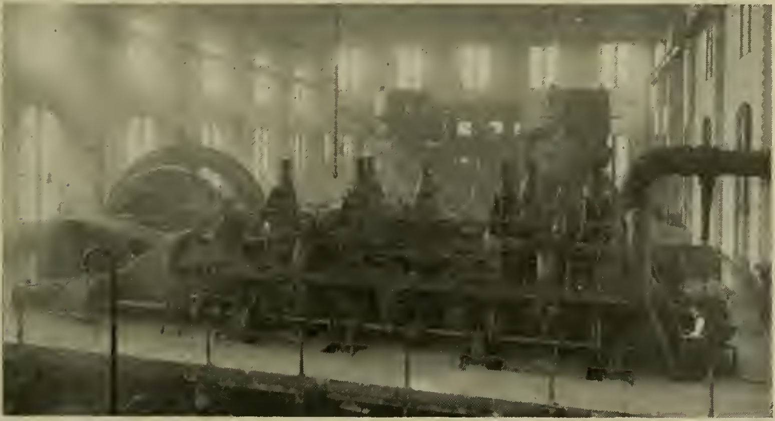


Fig. 18. Blast Furnace, Gas Driven Electric Unit, Bessemer, Pa.

Blast furnace gas	31%
Natural gas	43
Producer gas	22
Illuminating gas	3
Coke oven gas	1
Distillate, oil and gasoline	1.10 of 1%†

The appended installation views will partly convey to the mind how great an industrial factor gas power has become.

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*Estimated from N. E. L. A. report of Gas Engine Committee for 1910 (machines of 50 h. p. and above).

†Partial record only.

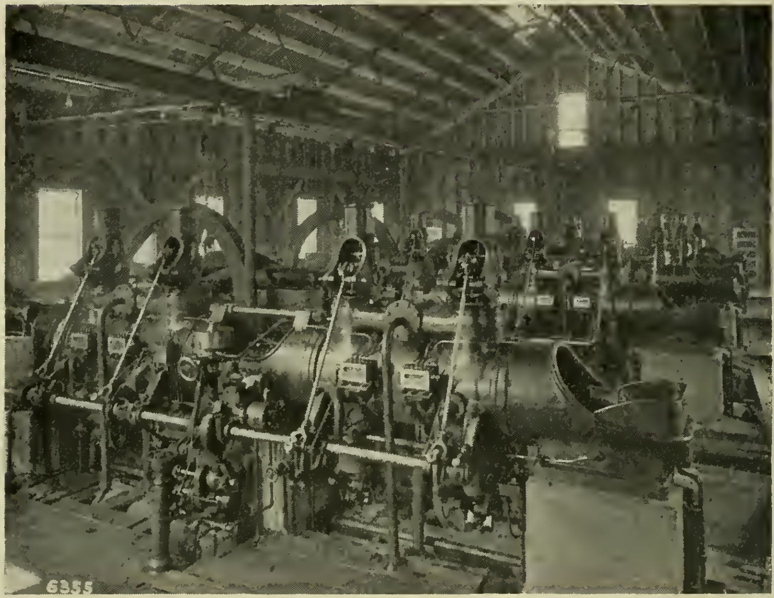

Fig. 19. Natural Gas Driven Compressors, Hope Natural Gas Co., Downes, W. Va.

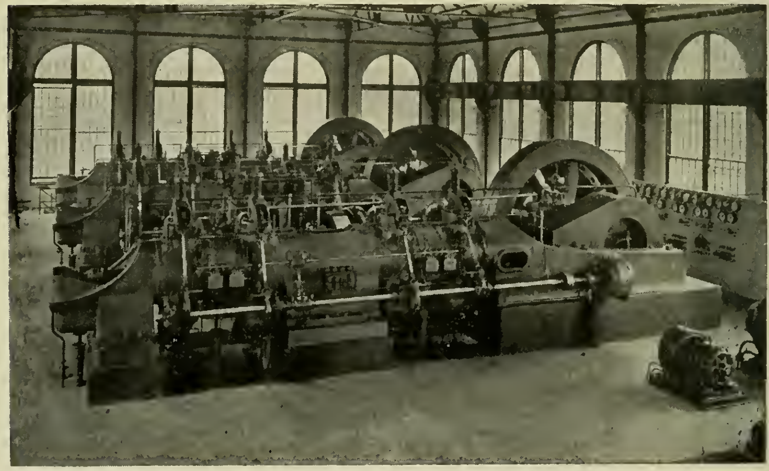

Fig. 20. Power Plant of the Union Switch & Signal Co., Using Natural Gas.

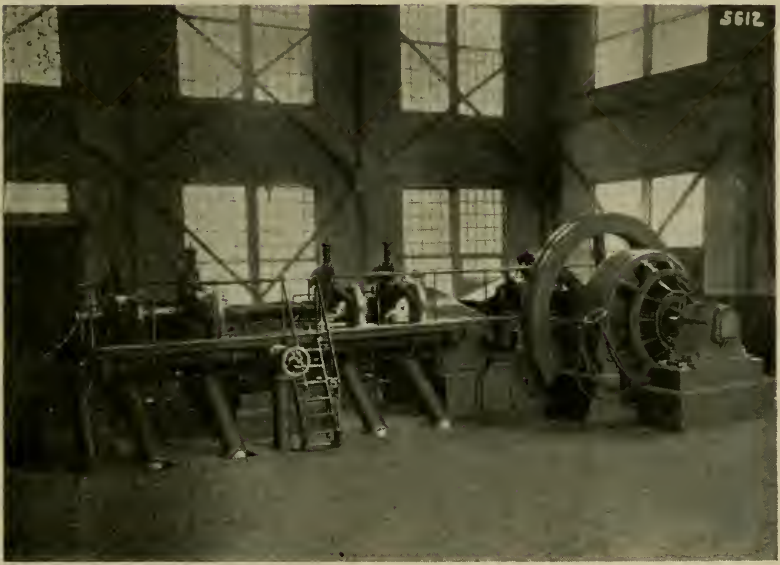

Fig. 21. Interior of the Engine Room of the American Locomotive Co.'s Producer Gas Power Plant, Richmond, Va.

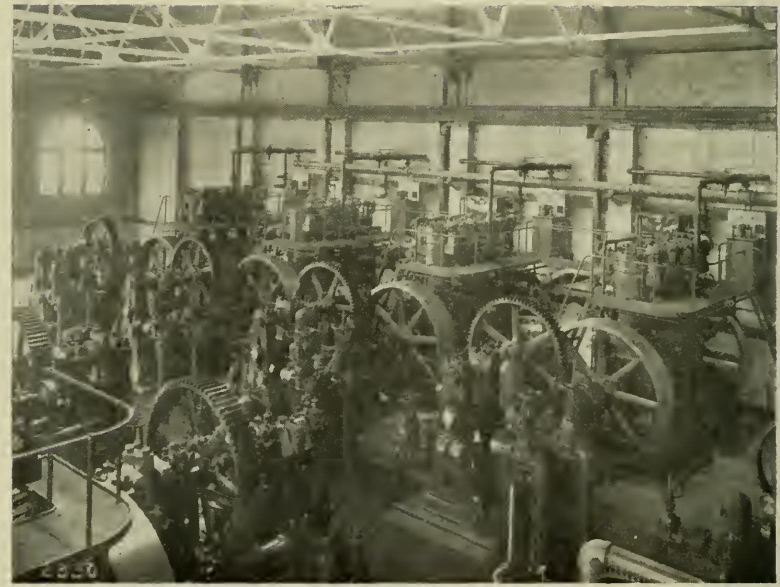

Fig. 22. Station No. 1 of the Philadelphia High Pressure Fire Service System. Using Illuminating Gas. Nine Engines in No. 1 and 11 in No. 2 Plant.

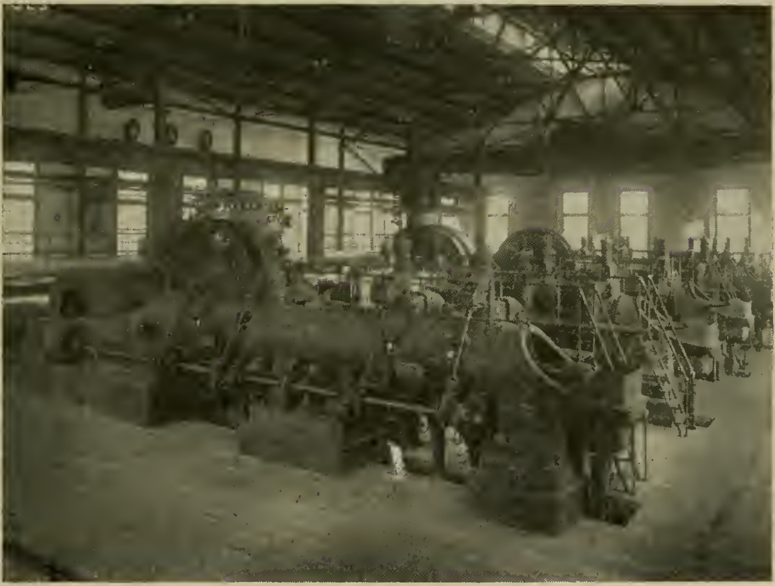

Fig. 23. Coke Oven Gas Power Plant, Cornwall Ore Banks Co., Lebanon, Pa. Three 750 Kw. Units.

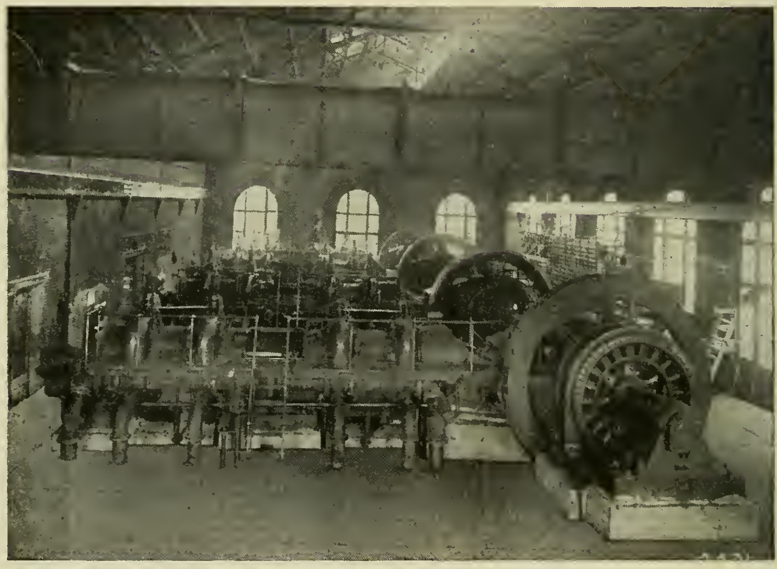

Fig. 24. Four Kw. Units, Operating on Oil Distillate at the Atlantic Refining Co., Point Breeze, Philadelphia.

Conclusions—In the admitted breadth of this important subject it has been impossible to give due emphasis to the variety of factors and conditions that individually are deserving of lengthy discussion. The author has endeavored, however, for the benefit of the members who have not in any way identified themselves heretofore with this phase of engineering, to direct their attention to its fundamental features without introducing complex or elaborate theory and descriptions.

PRESIDENT: We have with us Mr. D. P. Morrison, Electrical Engineer of the P. & L. E. R. R., and we would be glad to hear from him.

MR. D. P. MORRISON: Mr. President, most of us in the railroad business are familiar to a certain extent with the gas engine, some to our sorrow. The reason I say that is that in general gas engines are abused. We put them out and expect them to take care of themselves. We have heard an exposition of the gas engine tonight as a legitimate power system, while probably we had not thought of it as such heretofore. The speaker informed us that there are some 500,000 horse power total gas engines operating. A very large part of that number, however, are not operating in what we might call commercial power plants; a great many in blast furnace work, which is a special service, and a great many of them in the natural gas belt. Those matters do not apply to the bulk of us in our daily business, especially in the railroad business.

I remember when I was a student, 15 years ago, we were told that the gas engine was the most efficient prime mover that we had, but it had not been developed practically. Today we have it developed, but at the same time the steam turbine has been developed along as rapid lines and the two apparently are on a par. But the great field, it seems to me, for gas engines is in the producer connection, and I gather from the paper that that is the feeling of the author and of engineers who are working along these lines.

I must confess that the speaker has disappointed me in one respect, and that is in presenting a very attractive picture as to the efficiency of the producer in combination with the gas engine, and then rather shattering that by the assertion that to make it economical as compared with the steam turbine the cost of coal must be from $3 to $4. I am unable to follow the figuring exactly, because if we can produce our power at an expenditure of 1 to 1½ lbs. of coal per kw. hour, and if the operating expenses in connection with gas engines and the producer are comparable with the operating expenses of the steam turbine and boiler, then we have only the fixed charges, which would overbalance, and, according to the figures at about 40% load factor, the two are equal. I would like to have that point developed a little. I may have misunderstood the speaker.

It seems to me that the great opportunity and use of the gas engine is in the use of lignite fuels. I happened to be reading recently a discussion of that very point, and I was surprised at the vast amount of fuel of that description that has heretofore been considered of absolutely no value, which is presented for our use through the medium of the producer. I understand the efficiency of the apparatus to be practically the same with lignite as with high grade coal. Most of us have heard of the producer, but probably we have considered it rather as an adjunct to steel mill work or gas house work or something of that sort, and as being an apparatus which is rather complicated and requires a good deal of work in maintenance, and we do not perhaps think of it as having reached the point of development it has. I would like to ask the speaker whether he is ready to subscribe to the following, which I have taken from an article before one of the engineering bodies on somewhat similar lines.

MR. DREYFUS: Regarding the commercial aspect of the producer gas plant, it appears, as noted in the paper, limited to small sizes, for the reason that the large turbine plants are naturally on a parity from an efficiency standpoint. Some important steam stations in and about New York are able to produce a kilowatt hour on 2.2 lbs. of coal per kilowatt hour, with coal of 14,500 b. t. u.—the load factor ranging from 30 to 50%. This could hardly be exceeded by the gas plant. On the other hand, the greater investment burden and labor with the gas plant must be taken into account. Large engines require three or four men to operate them, while one man may easily take care of a 10,000 kilowatt turbine. One man in a boiler house may be placed in charge of 3,000 b. h. p., where stokers and automatic machinery are installed. In a producer plant, 2,000 h. p., and possibly less, is as much as one attendant may readily undertake. Thus the ratio of engine horse power per man is roughly as 3 to 1, for the boiler and producer plant respectively. Hence, the large gas engine finds its greater usefulness in the by-product and natural gas fields. Producer gas power is confined to units of 500 and 750 kw., unless both a high load factor and high cost of fuel prevail. The lignite beds of the West are generally unsatisfactory for boiler use, but may be gasified successfully in the producer. In such localities the producer plant should obviously predominate owing to the prohibitive cost of coal.

Much may be said regarding the troubles that have been experienced with the gas engine. In a great many of the cases, it may be attributed directly to the disposition of the operating engineer who probably has acquired his experience solely with the steam engine and is not given very kindly toward the gas engine. I am confident it will not prejudice the gas engine in saying that it requires the attendant to be more active than in the case of the steam engine or turbine. The explanation is, that if one does not keep the igniters in good condition, firing will cease in some of the combustion chambers, and the engine will slow down. There is naturally wear of the igniters, due to breaking the current. Usually, double igniters are furnished, and the engineer on watch may promptly change igniters should any become inoperative. In spite of what may be said in this connection, many engineers have told me that they really prefer operating a gas plant, which they have taken to with keen interest. If you have a steam engineer who is determined to adhere to his former way of doing things, you may get into trouble, but if you break in a new man, or have a steam engineer who is progressive, I dare say you will get just as great a degree of reliability out of gas power as you may from a steam plant. That is really the experience in a great number of our plants.

As regards the specifications recited, there is little doubt they may be complied with. In fact, many of our plants, even from the start, have been particularly free from any trouble whatever. Some corrections, in a few cases, were found necessary, but with the present design, and the experience obtained, we are prepared to enter the field and insure the satisfaction desired.

MR. MORRISON: You misunderstood what I said regarding the gas engine as a commercial proposition. Of course, it is a commercial proposition. But for general use in all parts of the country it is limited to liquid fuel or producer gas, because, as you stated in the paper, natural gas is not available except in certain favored localities, and blast furnace gas in only special localities.

MR. DREYFUS: At the outset it was shown that it has its usefulness in certain regions and disadvantages in others, so it really becomes a simple matter to analyze the situation and decide whether it may prove profitable.

MR. MORRISON: We have heard from time to time of some development in gas turbines. Has anything ever been done in that?

MR. DREYFUS: Considerable experimenting has been done, but the gas turbine has not yet been brought to a satisfactory stage of development. Consequently, I am able to say but little about them now. There is in France, however, a 300 h. p. experimental gas turbine in operation, and I understand it is running quite satisfactorily, though it is not very efficient. It is hard to design a gas turbine with compression, and consequently efficient combustion of fuel is sacrificed in this type of motor. No small amount of thought and time has been devoted to the subject, and a practical gas turbine may emerge from its present embryonic stage within the next few years.

PRESIDENT: Mr. M. A. Kinney, Superintendent of Motive Power of the Hocking Valley Ry., is in the audience and we would like to hear from him.

MR. M. A. KINNEY: Mr. Chairman, I do not believe I have anything further to offer than the remarks that have been made. I have been very much interested in the paper and in the discussion, but I could not add anything.

MR. C. A. LINDSTROM: What we are all interested in is the changing of the old high pressure steam plants into something more modern. I would like to know whether the speaker considers it economy to put in a low pressure turbine to utilize the exhaust steam or to tear out the old steam plant and put in a gas engine with a producer plant.

Second, in your cost figures was the cost of water figured in, if it has to be purchased?

What would be the comparative floor space as between gas engines with producers and reciprocating engines with boilers?

Is the gas engine designed to run high and low speed, suitable for both A. C. and D. C. generators?

Have you any idea as to the life of a producer, and if necessary to run continuously would it be expedient to have a double set of producers in order to get continuous power night and day?

What happens to a gas engine in case there is too much gas admitted? Are there proper safety valves?

MR. DREYFUS: First, in reference to the economy of tearing out an old steam plant and substituting a gas plant, I would inquire what may be the cost of the fuel that must be considered.

MR. LINDSTROM: Take run of mine coal at $1.50 a ton and using a producer with low grade coal.

MR. DREYFUS: The existing condition of the high pressure units must be ascertained, and if they are still physically good, it is very probable low pressure turbine should be installed. In this way the improvement will be obtained at the lowest cost, and at the same time virtually preserve the value of the present engines and boilers, which otherwise must be sacrificed at salvage. This would further react as an additional charge on the producer plant, and augment the already heavy fixed burden should the steam engines be badly worn and beyond reasonable repair. It would be necessary to balance the ultimate cost of the gas producer plant vs. the steam turbine plant, as outlined in the paper.

Water was not included in the estimate of cost. In a condensing plant, if the water supply is contaminated and fresh water expensive, a surface condenser would be installed, and the condensate returned to the boilers. A small make up supply—15 to 25%—would be necessary. The gas engine plant may also use a poor character of water for cooling purposes, although it has its evident objections. There would then be little difference, regarding them on a water basis. In non-condensing operation, the water consumption may become an important item. Where the water supply is unsuitable or insufficient, a cooling tower should be considered. In a gas plant, the cooling tower will cost the least, as the water is used at high temperatures, favorably influencing atmospheric evaporation.

There is no necessity for a double set of producers for continuous operation. Sufficient spares may be considered depending on the nature of service. No safety devices are required to protect the cylinders against abnormal explosions. The maximum possible explosion pressures are only obtained with a full cylinder filling of combustible mixtures, for which conditions the engine is safely proportioned. In fact, such a case would only represent the ultimate overload ability of the engine.

MR. LINDSTROM—Does the cost of installation include boilers?

MR. DREYFUS: Yes. But what is quoted is only nominal for the size selected. It varies according to both size and local condition. With the larger plants, the unit cost invariably decreases.

As to the relative floor space, the gas plant requires about 50% more than the turbine plant—this including the boiler and producer house.

The speed of the engine is not greatly affected, whether the generator be D. C., or 60 or 25 cycle A. C.—the generator design provides more or less poles.

As to the lining of the producer, that depends upon the care the producer receives, but I consider its life to be several years ordinarily, if a good quality of brick is used. We had our first experimental producer in use over a year trying it out on the various kinds of fuel described. When the fire was first withdrawn, after a year's continuous service, the lining was found in very good condition. A negligible amount of clinker only had adhered to the walls.

MR. A. STUCKI—I was exceedingly interested in what the speaker said about making use of the exhaust heat. I am sure this will introduce the gas engine in some places where it has been barred heretofore.

I now would like to ask the percentage of power furnished by bituminous producers. You already stated the percentage of it from soft as well as hard coal combined, but I would like to know how much is produced from bituminous coal. For instance, there is a plant at Richmond. Is it bituminous?

MR. DREYFUS: It is a bituminous plant. The Government publication on producer power plants, prepared under the direction of Prof. Fernald, shows that the bituminous and lignite plants exceed the anthracite plants in horse power, at the present time, by two and one-quarter times.

Mr. Morrison inquired if the same efficiency is obtained with the varying qualities of fuel, and I would like to say it is my opinion that the change is very small. The consumption in pounds of fuel will, obviously, vary directly in proportion to the change in heat value. If you have lignite at 6,000 B. t. u., you require two pounds per brake horse power, as against one pound of Pittsburg coal of 12,000 B. t. u., but the efficiency holds up very well indeed.

MR. STUCKI: I meant to ask also about the relative temperatures of the upper zone and the lower zone.

MR. DREYFUS: The fire zone is about 2000° Fahr., and the fixing, or reaction zone, is in the neighborhood of 1200 to 1500°. The gas comes off this at about 1000°, but is immediately cooled by the scrubbing water.

MR. LINDSTROM: Mr. Dreyfus has presented a paper tonight that is, as far as I am concerned, one of the most interesting I have had the pleasure of listening to, and I suppose many of you feel the same way. The thanks of the Club are due to Mr. Dreyfus, and I therefore move that we extend to him a rising vote of thanks.

The vote was extended unanimously.

PRESIDENT: Mr. Dreyfus, you have the thanks of the Club.

There being no further business,

ON MOTION, Adjourned.

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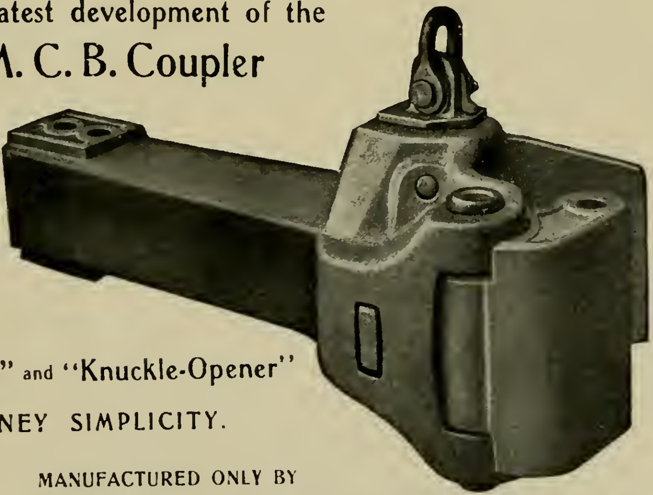

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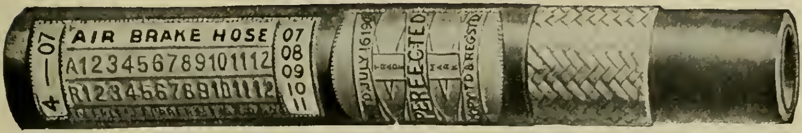

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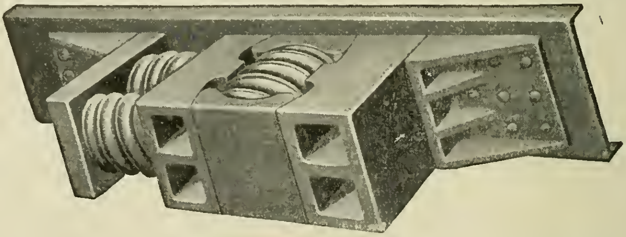

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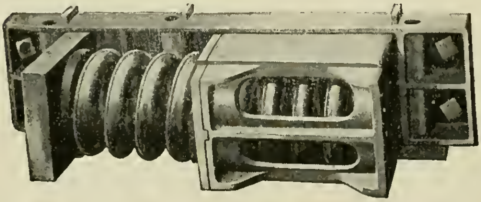

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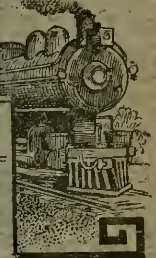

Vol. X. December 23, 1910 No. 2.

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TO MEMBERS:

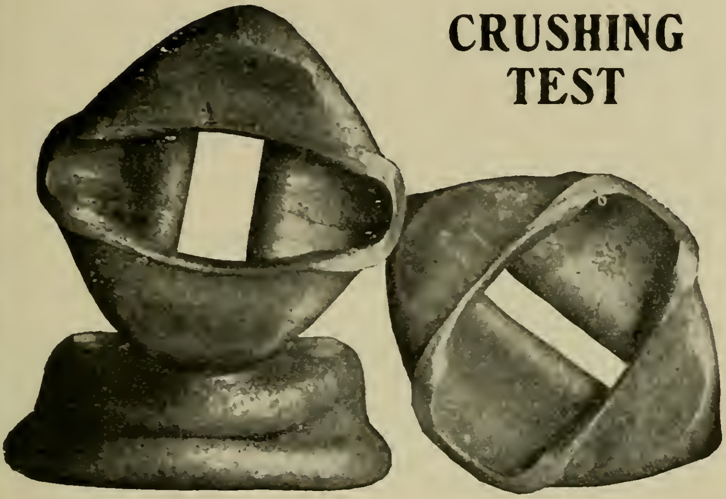
Our Standing Committee on Interchange Rules will hold their meeting on Tuesday, March 7th, 1911, to formulate their report of recommendations for changes in the Master Car Builders' Rules. Mr. R. L. Kleine, Chief Car Inspector, Penna. R. R. Co., Altoona, Pa., is Chairman of this Committee. Any of the members of the Club having recommendations for changes in the Rules will please forward same to Mr. Kleine on or before March 1st 1911.

Yours truly,
C. W. ALLEMAN,
Secretary.

Pittsburgh, Pa.,
February 1st., 1911.

Tests of Spellerized Steel Boiler Tubes (5*)

CRUSHING TEST



Specimens, 2½" long, crushed by repeated blows of a steam hammer. This test shows that the tube will stand extreme punishment without evidence of defects. Should the weld open or wall fracture, such a tube is rejected.

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*This is the fifth of a series of announcements in reference to the qualities of, and the tests given to

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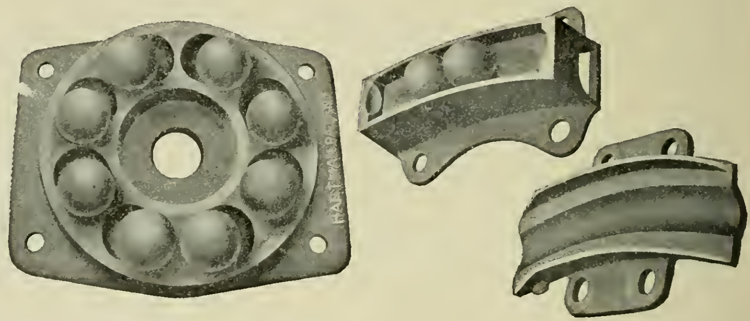

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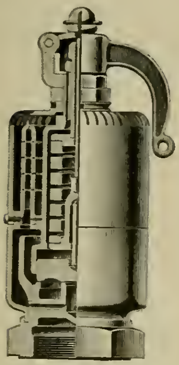

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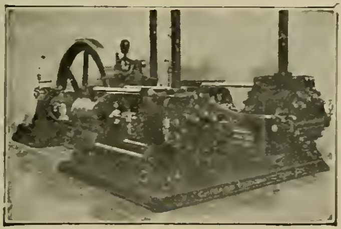

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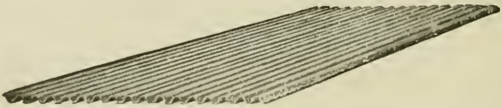

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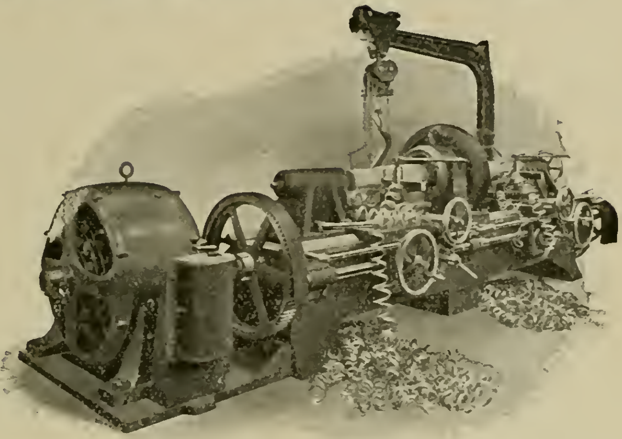

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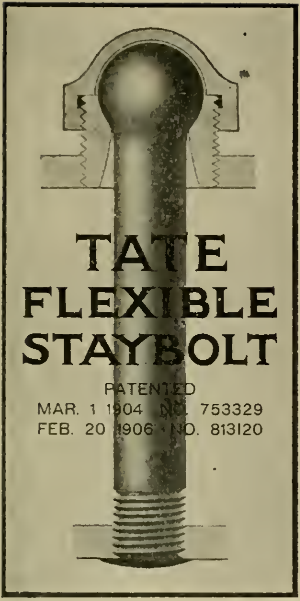

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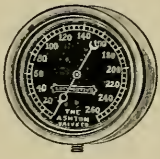

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INDEX—ADVERTISERS.

NAME	Page
American Brake Shoe & Foundry Co.	iii
American Locomotive Company.	viii
Ashton Valve Co	xi
Ball Chemical Co	ii
Brady Brass Co	Front Cover
Butler Drawbar Attachment Co	xviii
Chicago Pneumatic Tool Co	v
Clancy, J. R	xvii
Cleveland City Forge & Iron Company	Front Cover
Crosby Steam Gage & Valve Co	v
Damascus Brake Beam Co	xvii
Dixon, Jos., Crucible Co	vi
Flannery Bolt Co	xi
Fort Pitt Malleable Iron Co	xii
Franklin Manufacturing Co	xviii
Galena-Signal Oil Co	xii
Gold Car Heating & Lighting Co	vi
Gould Coupler Co	ii
Homestead Valve Mfg. Co	iv
Hunt-Spiller Mfg. Corp	xi
Lawrenceville Bronze Co	xv
Lino Paint Co	Back Cover
Long, Chas. R. Jr. Co	iii
Magnus Metal Company	vi
Manning, Maxwell & Moore	iii
McConway & Torley Company	xv
Nathan Manufacturing Co	iv
National Car Wheel Co	iii
National Malleable Castings Co	vi
National Tube Co	i
Niles-Bement Pond Co	ix
Page Woven Wire Fence Co	Front Cover
Peerless Rubber Mfg. Co	xvii
Pittsburgh Coal Co	iv
Pittsburgh Equipment Co	Back Cover
Pittsburgh Testing Laboratory	Front Cover
Pressed Steel Car Co	xx
Railway Steel Spring Co	xvi
Safety Car Heating & Lighting Co.	xvi
Sipe, James B. & Co	Front Cover
Standard Coupler Co	xix
Standard Steel Car Co	xviii
Steel Car Forge Co	Front Cover
Suydam, M. B. Co	Back Cover
Union Spring & Mfg. Co	xiv
Union Steel Casting Co	xix
Ward Equipment Co	xix
Washington Coal & Coke Co	ix
Western Railway Equip. Co.	Front Cover
Westinghouse Air Brake Co	vii
Westinghouse Electric & Mfg. Co.	vii
Westinghouse Machine Co	vii
Wood, Guilford S	Front Cover

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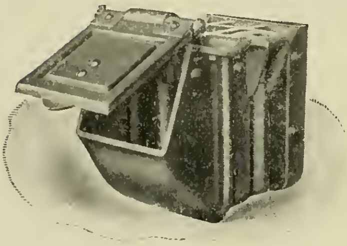

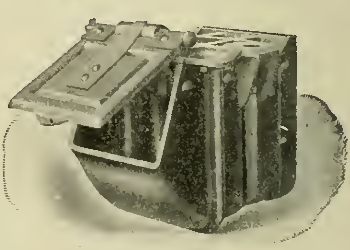

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of the
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ORGANIZED OCTOBER 18, 1901.

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VOL. X. No. 2. **Pittsburgh, Pa., December 23, 1910.** $1.00 Per Year 20c Per Copy

Published monthly, except June, July and August, by the Railway Club of Pittsburgh. C. W. Alleman, Secretary, General Offices P. & L. E. R. R., Pittsburgh, Pa

Meetings held fourth Friday each month, except June, July and August.

PROCEEDINGS OF MEETING,
DECEMBER 23rd, 1910.

The meeting was called to order at the Fort Pitt Hotel, Pittsburgh, Pa., at 8:00 o'clock P. M., with President F. R. McFeatters in the chair.

The following gentlemen registered:

MEMBERS.

Alleman, C. W.
Amsbary, D. H.
Barth, John W.
Beatty, E. A.
Bell, W. K.
Bennett, R. G.
Black, F. J.
Blakely, T. M.
Brown, L. M.
Bryant, C. W.
Bulkley, B. M.
Burry, Vincent J.
Christiansen, A.
Cline, W. A.
Conway, J. D.
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Courtney, D. C.
Craig, E. M.
Crouch, A. W.
Deckman, E. J.
Drayer, U. S.
Falkenstein, W. H.
Gilg, Henry F.
Grewe, H. F.
Hamilton, Wm.
Huyett, E. G.
Hyndman, F. T.
Keptner, J. B.
Keyser, R. H.
Loudenbeck, H. C.
Lynn, Samuel
Mason, Stephen C.
Matthews, J. A.
Millar, C. W.
Mitchell, A. G.
McFeatters, F. R.
McKeen, J. W.
McNulty, F. M.
Oates, Geo. M.
Orner, Milton T. S.
Pape, Chas. F.
Peters, W. P.
Postlethwaite, C. E.
Rabold, Wm. E.
Rhodes, P. L.
Robinson, J. R.
Robinson, S. R.
Rupp, R. D.
Schuchman, W. R.
Schultz, Geo. H.
Shannon, Chas.
Simpson, M. S.
Smith, Russell
Snyder, K. G.
Stafford, Samuel G.
Stark, F. H.
Storrs, Chas. P.
Stucki, A.
Sweeley, G. P.
Taylor, H. G.
Thomas, J. H.
Walther, G. C.
Warne, J. C.
Wood, Ralph C.

VISITORS.

Brown, E. W.
Conway, Scott M.
Dickerman, W. C.
Fawcett, James
Gilg, Harry F., Jr.
Lang, William C.
Mason, E. F.
McCombe, Wm.
McNaight, A. H.
Smith, Sion B.
Toomey, J. J.
Warne, P. J.
Weckler, H. L.
Wilson, Herbert M.
Wood, E. R.

The reading of the minutes of the last meeting was dispensed with, they being in the hands of the printer.

The Secretary read the following list of applications for membership:

Carroll, J. T., Superintendent Motive Power, B. & O. R. R., House Building, Pittsburgh, Pa. Proposed by Geo. A. Gallinger.

Cullen, J. C., Train Master's Clerk, Monongahela Connecting R. R., Apartment No. 19, The Oakland, Halket and Forbes Sts., Pittsburgh, Pa. Proposed by F. M. McNulty.

Davis, J. E., Master Mechanic, Hocking Valley R. R., 396 Stoddart Ave., Columbus, Ohio. Proposed by A. W. Crouch.

Faris, J. M., Master Mechanic, Youngstown Sheet and Tube Co., Youngstown, Ohio. Proposed by H. E. Metcalf.

Kennedy, W. J., Clerk, B. & O. R. R., 600 Liberty St., N. S., Pittsburgh, Pa. Proposed by John J. Publow.

Mason, E. F., Inspector, Motive Power Dept., Penna. R. R., Union Station, Pittsburgh, Pa. Proposed by J. B. Anderson.

Mowry, F., Asst. Road Foreman of Engines, Penna. R. R. Co., Derry, Pa. Proposed by O. C. Coho.

O'Connor, M., Rep., Chicago Pneumatic Tool Co., 10-12 Wood St., Pittsburgh, Pa. Proposed by C. W. Alleman.

O'Leary, D. W., Rolling Mill Foreman, Carnegie Steel Co., Schoen Steel Wheel Works, 405 Russelwood Ave., McKees Rocks, Pa. Proposed by F. J. Black.

Regan, W. J., Mechanical Engineer, McConway & Torley Co., Forty-eighth St. and A. V. Ry., Pittsburgh, Pa. Proposed by I. H. Milliken.

Schaefer, Frederic, Mechanical Engineer, Summers Steel Car Co., Oliver Building, Pittsburgh, Pa. Proposed by A. Stucki.

Smith, Edward B., Rep., American Brake Shoe & Foundry Co., 30 Church St., New York, N. Y. Proposed by E. G. Beatty.

Smith, Geo. H., Draughtsman, Carnegie Steel Co., 28 Fourth St., Aspinwall, Pa. Proposed by F. L. White.

Summers, J. Mills, Summers Steel Car Co., Oliver Building, Pittsburgh, Pa. Proposed by A. Stucki.

Waddell, F. W., Asst. Master Mechanic, Schoen Steel Wheel Co., 749 Frederick St., McKees Rocks, Pa. Proposed by F. J. Black.

Weckler, H. L., Shop Engineer, American Locomotive Co., 1924 St. Marks Place, Allegheny, Pa. Proposed by E. A. Beatty.

PRESIDENT: As soon as these names have been favorably passed upon by the Executive Committee the gentlemen will become members.

If there is no further business we will proceed to the paper of the evening, by Mr. H. M. Wilson, Engineer in Charge, Department of the Interior, Bureau of Mines, on the subject, "Efficiency in Fuel Combustion." I take pleasure in presenting to you Mr. Wilson.

EFFICIENCY IN FUEL COMBUSTION.

BY MR. HERBERT M. WILSON, ENGINEER IN CHARGE, DEPARTMENT OF THE INTERIOR, BUREAU OF MINES, PITTSBURGH.

Mr. President and Members of the Railway Club of Pittsbrugh:—It affords me unusual pleasure to meet you and to address you on the subject assigned me. The railroads represent the largest single group of coal consumers in the country. So vast is the extent to which the coal produced in this country is used on railways that it has been estimated that in 1906 one-fifth of all the coal, anthracite and bituminous, mined in the United States was consumed in locomotives in that year. The gross amount of this coal consumption was not less than 90,000,000 tons, used in the operation of about 51,000 locomotives. In this year the coal bill of the railways of the United States aggregated $170,000,000.

Two years later, in 1908, statistical reports show a coal production in the United States of over 415,000,000 tons. The very carefully prepared report of the Federal Conservation Commission estimated that nearly an equal amount of coal was lost to future use in the getting of this coal. This waste was the result of prevalent methods of mining, whereby only the highest grade of coal is extracted, that of inferior grade being left in the ground or otherwise wasted, because not of marketable quality.

The same commission reported an enormous loss of fuel value in the conversion of the latent energy of the coal into work as power or light. With the aid of a number of authorities on fuel combustion it was estimated that in the average steam power plant about 6% of the fuel energy does useful work, while less than 1% is converted into the light emitted from the electric lamp, over 99% being lost. In the case of power production through steam with some of our most modern insulations in large units, as central power stations for generating electricity, as much as 10% of useful work may be produced. The losses occur in starting the fires, in vaporizing the moisture in the coal, in exhaust steam, in radiation from boiler and pipes, in gases discharged through the stack, and in ashes; while another large portion is lost in the engine through friction, inertia, lost motion, etc.

In reporting for the Geological Survey on investigations concerning the use of fuel in locomotive practice Professor W. F. M. Goss stated that but about 40,000,000 out of 90,000,000 tons consumed in locomotives in 1906 represented heat transmitted from the furnaces to water to be vaporized. Adding to this the losses by radiation, in transmitting the steam power through the engine to the axles, adhesion to the rails, etc., it is estimated that of the latent heat value in the coal, probably not over 5% does useful work in moving the trains forward, the remaining 95% being wasted.

While it is, of course, altrustic to assume that any large proportion of the latent fuel energy now lost in power production will be saved to useful work during the lives of any here present, I believe that we are warranted in bringing the above facts clearly to the attention of the public through the medium of engineers and operating officers such as yourselves in the hope that thereby fuel users may be induced to give more careful consideration to possible means of more economic fuel combustion.

Moreover, users and inventors by having their attention attracted to these conditions, may push forward more rapidly those improvements and methods which must ultimately result in betterment. It is unnecessary to tell you that I, no more than you, do not consider that the millenium is here. On the other hand, about 25 years ago the fuel waste in power production in the average stationary plant in the United States showed a loss in useful work of about 96% and useful work performed of about 4%. Probably the best performance at that time in stationary steaming practice was between 5% and 8%. Today such power plants as those of the Chicago Edison Company, the Interborough Rapid Transit Company and others show useful work performed by 10% of the latent fuel value, and an average for all stationary plants in the country of 6%. Think what means a saving of the latent energy in coal of only 5% when only this percentage does useful work. This would mean an increase of 100% in work performed. With an annual production of 500,000,000 tons this, alone, represents a saving of 250,000,000 tons to get the same amount of power. This, at an average cost of $1.00 per ton, is equivalent to $250,000,000 saved through more efficient conversion of coal into steam power.

A quarter of a century ago there was not a producer gas plant in operation in the United States. Today there are estimated to be 500 such plants, some of unit capacity of 5,000 or 6,000 h. p. and producing, in all, nearly 120,000 h. p. It is well known that producer gas can be manufactured from coals of such low grade as to be valueless for steaming purposes, thus saving that much of the higher grade coal for other uses. It is also well known that, on the average, the producer gas plant today converts into useful work from 10% to 16% of the latent energy of the fuel, the average being over 13%. Where such means of power production are economically substituted for steaming plants an average saving in fuel value may be effected of 5% to 8%. Here again the figures run into the millions of dollars, not to mention the extension of the probable life of the existing fuel resources of the country.

Much of the coal discarded to the culm bank in the anthracite regions has been recently proven a valuable source of fuel, not only in the gas producer but for use in the boiler furnace by conversion into hard nodules called briquets. By briqueting anthracite culm, and bituminous slack at the mines, a further source of fuel saving has been developed. So, also, within a half generation, further enormous waste through the fuel gases of the blast furnace, the bee-hive coking oven, and similar appliances have been proven unnecessary and avoidable.

Until recently it has been customary in mining to leave an average of 50% of the available coal in the ground, a loss to all future time, and to discard all other valuable coal prior to the more general introduction of washing and sorting methods as now practiced. It is conceivable that with better practice, as evidenced in Europe, and with more favorable commercial and transportation conditions these mine wastes may be reduced to 25% or less. This would represent a saving to the future of one-quarter of the present annual production of 500,000,000 tons.

For the above reasons the Congress of the United States, and through it the Secretary of the Interior, have directed that the recently created Bureau of Mines shall devote its first energies to an investigation of the problems connected with the mining, preparation and marketing of coal, and its conversion to commercial use. Beginning under the Geological Survey in 1904, fuel investigations were undertaken in a small educational way at the Louisiana Purchase Exposition. Since that time commercial steaming tests have been made by the Government on nearly 500 different coals from the various mining regions of the United States. Nearly 200 producer gas tests have been made upon an almost equally large variety of coals in both up draft and down draft gas producers. Fifty tests have been made of coals from different parts of the United States, to determine their coking value, and whereas many of these coals were not believed to be coking coals, methods of washing, mixing and firing them have been developed which show some to be valuable for coking purposes. In like manner commercial tests have been made on carload lots of high grade coal, on slack and on culm and lignite, to determine the best methods of converting them into briquets and ascertain the efficiency of these when burned by different means in stationary and locomotive furnaces and domestic heating and cooking stoves.

With the results of these preliminary investigations before them, and with the removal of the uncertainty surrounding the work in the Geological Survey, due to the hand-to-mouth method of making annual appropriations for one branch of a bureau, it is now possible for the officers of the Bureau of Mines to plan broadly and deeply for the future.

This investigative fuel testing work by the Federal Government is not to be confused with that variety of testing conducted by commercial institutions, railways and power plants. These have as their primary object the testing or development of the machine. The investigations of the Federal Government have as their primary object the better utilization of the fuel resources of the country. The Bureau of Mines tests are, therefore, not competitive or investigative tests of the various makes of power producer, but they have in view the ascertainment of the best existing type of commercial appliance in which to burn with highest efficiency each separate variety of fuel. They are also planned with a view to learning something of the fundamental principles underlying fuel combustion in various appliances, in the hope that thereby inventors and manufacturers may develop improvements in them.

The Bureau of Mines has another function to perform in connection with its fuel tests which has led to much misunderstanding of its purposes, and some unwarranted criticism. Used as a testing laboratory by the several hundred purchasing officers charged with the procurement of fuel for the power plants in hundreds of public buildings scattered from Maine to California, in the power plants of the Isthmian Canal Commission, the steamships of the Panama Railway, the heating plants of the various military posts and Indian agencies, the Bureau of Mines is charged with the duty of protecting the Government to the extent of ascertaining that the quality of coal furnished by contractors is the highest procurable under the specifications. Of over 400,000 tons of coal shipped annually to the Isthmus of Panama, and 100,000 tons consumed in Panama Railway steamships, specifications calling for an unusually high grade fuel have been adopted by the government purchasing officers, as would be done by those of any commercial institutions which aimed at economic business management. It would be unprofitable to transport from the mines to the Isthmus the vast tonnage represented in an unnecessarily high ash or moisture content.

On the other hand, the Bureau of Mines has been instrumental in the cases of many public buildings throughout the United States, and in the forty odd buildings in Washington, in indicating how, by comparatively minor changes in existing equipment or replacement thereof, or different methods of manipulation therein, it is possible to burn advantageously lower grade coal, bituminous coal or buckwheat anthracite, in place of high grade and expensive steaming coal or furnace anthracite previously in use. In one public building in Washington alone it is estimated that a saving of $15,000 was made by change of furnace equipment, whereby buckwheat was substituted for furnace anthracite. In buildings there and elsewhere the use of bituminous coal has recently been introduced through the agency of this bureau, thus encouraging, so far as possible, the use by the Government of the cheaper low grade and comparatively waste fuels in places of the more expensive and scarce high-grade fuels.

It is well known, perhaps, to many of you that when coal is contracted for and sold under some trade name such method of sale gives little opportunity for the purchaser to determine an inferior delivery in case the vendor is short of the coal contracted for. Moreover, the purchaser would have little recourse in the courts, especially if much of the coal has been consumed. The Bureau of Mines and its predecessor, the Geological Survey, have consistently advocated the purchase of coal on a specification which fixed the heat value of the fuel offered. Such an arrangement is eminently fair both to seller and purchaser; the chemical analysis and test determines the number of heat units, or British thermal units, in the average sample, and according as the delivery is above or below, premiums or deductions are made in settlement. No question need be raised as to the rejection of the delivery for the purchaser will pay a less price for an inferior quality. In other words, he will get what he pays for and the vendor will be paid for what he sells.

Today the United States Government, which, through its many agents, is the largest single purchaser of coal, buying annually an amount estimated considerably in excess of 6,000,000 tons, is procuring 3,000,000 tons of this on specifications fixing the number of British thermal units. The remainder of its fuel purchases, chiefly those for the navy, have been practically reduced to an equivalent basis through the tests and mine data furnished the navy purchasing officers. Nevertheless, this feature of the work of the Bureau of Mines, as previously stated, has brought some criticism of its apparent encouragement of the use of only high grade coal, is the least of that Bureau's operations in connection with fuel investigations.

I have called your attention to the many hundred steaming investigations made by the Bureau of Mines. These tests have been made on horizontal return tubular and on water tube boilers of standard make, used in the daily power production at the testing station here in Pittsburgh. They have covered such a wide range of fuels that they may be characterized as a combustion survey of the coal of the United States. These coals are burned in furnaces in which the baffling is changed from time to time. They are hand-fired or mechanically stoked, with under-feed, over-feed or chain grate stokers. The draft may be natural, forced or induced, or a combination of the latter. It has thus been possible to determine in a preliminary way what type of furnaces, how baffled, how fired, how stoked, and with what draft, each coal should be burned in order that it may produce the highest efficiency, and emit the least smoke. Similar investigations on some hundred coal purchases in different parts of the United States for use at army posts have been conducted on three types and sizes of heating boilers; a small one for heating a residence building or officers' quarters, a larger one for heating a medium-sized hospital or medical hall, and a good sized boiler for heating a large barrack building. In the latter connection a series of tests is now in progress to ascertain the most efficient and most smokeless method of using the different coals in a horizontal return tubular hand-fired boiler of medium capacity—50 h. p.

In each test a mining engineer of the Bureau samples the coal as mined and as loaded in the cars; samples are taken when unloaded at the testing station and as fired. A bulletin is in course of preparation setting forth the result of the proximate analysis, calorimetric determinations, and ultimate analysis, of nearly 5,000 mine samples, of which the origin and history is authenticated. With this information it is possible for the Government representives, and it should be for those of railway and commercial institutions, to predict the character of the coal which can be furnished them from any mine in the United States. Through the medium of the ultimate analysis it has been possible to detect that coal specified by the name of a colliery or coal field, for instance as Pocahontas No. 3, did not come from that seam, but from some other seam carrying a less high grade coal, though drawn from the same shaft and through the same tipple.

In the course of these tests feed water is weighed and analyzed, clinker and ash are weighed and analyzed, and fuel analyses and temperature measurements in the furnaces and in the flues are taken. These data furnish an invaluable index to the best method of utilizing each coal and for pointing the way for future investigations along these lines.

The gas producer investigations, the briqueting and coking investigations have been accompanied by similar care in fuel sampling, and in chemical and physical analyses and measurements.

With more fixed appropriations and the permanency of the work better assured, the Bureau of Mines has, since its organization in July last, procured the equipment and commenced investigations of a more fundamental nature based upon these preliminary tests. An exaggerted furnaced, named a long combustion chamber, has been perfected and put in operation. This is nearly 45 feet in length from the fire door to the boiler tubes and approximately three feet in rectangular inside cross section. The inner lining is of fire brick, separated by an insulated space from the outer portion of common brick. At every five feet of its length are peepholes and work-holes where the appearance of the flames may be observed, and temperatures measured and gas samples taken from any part of the cross section. In all, thirty-six simultaneous gas samples may be taken in different parts of the furnace.

In this appliance coals will be burned under fixed conditions of firing and draft, and it is believed this will lead to a better understanding of the fundamentals of fuel combustion. It should be possible to determine just what length of furnace is necessary to procure the most efficient mixture and highest temperature in the fuel gases from any coal, and that necessary for the emission of the least smoke. These first investigations will be followed by others in which different arrangements of baffling or different cross sections will be given the combustion chamber. The present cross section is not unlike that of a locomotive, and the results should, therefore, be of value to those interested in locomotive practice.

Having investigated producer gas generators of commercial types, the Bureau of Mines has just completed the installation of an experimental producer of moderate size which may be operated either as a pressure or as a suction producer. It is so arranged that gas samples and temperatures can be taken at various points in the fuel bed, the formation of clinker be studied, and the problems concerning the efficiency of the fire-brick lining, and the several processes which take place within the producer can be thoroughly investigated. The preliminary tests in this apparatus will have to do with the effect of depth of fuel bed, different ratios of air to steam, and with different rates of combustion with various types of fuels.

In the producer gas tests heretofore run no difficulty has been experienced in making runs of a week duration on any fuel, including the most volatile, moist or high ash bituminous coal, lignite and peat. Comparisons of the several hundred tests run on coals from different parts of the country in the steam boiler and the gas producer, are most interesting. The gas producer operated in the best way with West Virginia coal produced 3.3 times as much efficiency as did the steam boiler of the best type operated on the same fuel in the best way in test practice. The lowest grade of lignite developed, in the gas producer, about the same efficiency as did the best steaming coal under the boiler.

The preliminary briquetting tests have proven the value of this manufactured product as a substitute for run-of-mine coal under certain conditions. The coal is ground and mixed with a small percentage of binder, usually five or six per cent. of pitch. It is then heated and briquetted under a pressure of one or two thousand pounds per square inch. These coal briquets burn from the outside, giving off the volatile matter slowly and coking as the combustion proceeds until the entire briquet is consumed. They burn much as does furnace anthracite. A number of carloads of lignite each from Texas, California and Dakota have been successfully briquetted at the Pittsburgh testing station of the Bureau of Mines. For this purpose the lignite is disintegrated, then dried to free it from excessive moisture, and is then briquetted under great pressure, about 20,000 pounds per square inch, the resulting briquets being nearly as firm and hard as anthracite. They are especially well adapted for combustion in locomotives or in house heating furnaces and ranges. This fuel, like slack coal, may be had at the mines at about $1.00 per ton; adding $1.50 for manufacture and binder, a product is obtained at $2.50 per ton at the mine which compares favorably with high grade bituminous or anthracite coal. Since the Government and the railways own some millions of acres of lignite in the West, this will undoubtedly be an economical source of coal supply when its manufacture on a commercial scale is perfected. Many of you will recall the conditions under which, a few years ago, a coal famine occurred in midwinter in North Dakota. This was due, in a large measure, to the reliance of that region on the slack coals of neighboring states, which could not be carried long in storage and called for daily deliveries. Heavy snow-drifts impeded transportation and the resulting suffering ensued. Briquetted lignite from local sources can be carried in storage throughout the winter months.

The damage which smoke inflicts each year in the United States has been estimated to amount to several hundred million dollars annually, in the destruction of merchandise, the defacement of buildings, the injury to animal and plant life, and the greatly increased labor and cost of housekeeping. The Bureau of Mines has given much attention to this question through the medium of its combustion tests of coal. The tests made indicate clearly that the production of smoke in stationary power plants is unnecessary when proper equipment and operation are provided; that, though bituminous coal will produce more or less smoke in many types of furnaces, practically every coal can be burned smokelessly, and, therefore, with increased efficiency in some existing type of furnace.

Smoke reduction is largely a question of recognizing the fact that there are very many kinds of coal and that each requires a different combustion chamber, rate of draft, grate area, and method of stoking, to produce from it the most efficient and smokeless operation. For railroads the problem of smoke abatement is a much more difficult and complicated one than for stationary power plants, as it is also in certain furnaces and smelting operations. Fortunately, we are coming to realize that the emission of smoke is not the badge of prosperity, it has in the past been thought, but is, on the contrary, a sign of inefficient or ill-directed management. In the practical solution of the smoke problem a fatal error to be avoided is the enactment of a stringent ordinance. Such measures elicit only antagonism. The real campaign must be one of education.

In closing, Mr. President and gentlemen, I wish to again express my appreciation of this opportunity of addressing you, and to add that, while I have endeavored not to burden you with the technical details on which the above statements are based, I will be glad to discuss them at any time with any of you who may be interested.

PRESIDENT: Would any one like to ask any questions on the paper? We have with us this evening Mr. E. M. Craig, Smoke Inspector of the P. R. R., and we would like to hear from him.

MR. E. M. CRAIG: Mr. Chairman, Mr. Wilson's paper was very interesting, especially so to me as I have been a smoke inspector for about five years, during which time I found it a very difficult matter to entirely eliminate smoke of our locomotives. This is particularly true in shifting service, and in order to obtain better results we adopted the use of low volatile coal on engines working in this service, which step I consider very effective in reducing the emission of smoke from engines in shifting service.

PRESIDENT: Mr. J. B. Keptner, Coal Inspector of the P. & L. E., is present and we would like a word from him.

MR. J. B. KEPTNER: Gentlemen, this is the second time I have visited the Club. I have listened to the reading of Mr. Wilson's very interesting paper with a great deal of enjoyment. As I come under the title of inspecting fuel coal for locomotives one of my duties is to see about the preparation of the coal at the mines.

Some people do not pay much attention to the preparation of the coal for locomotives, but I think it is one of the most interesting points about fuel. We all know there is good coal and bad coal, and we all know that an engine cannot be fired with slate or sulphur. When a fireman gets on an engine that has a dirty tank of coal you do not know what he is going to say, but nine times out of ten he may have a steam failure as the result of a large percentage of sulphur in the coal.

I travel around among a great many mines and see a great deal of coal shipped out to various companies and I see some companies get a very poor grade of coal. My first idea is to see that the miners are getting a good grade of clean coal out of the mine. If they are not and are loading the dirty coal, such as slate, sulphur, bands, binders, bone, dirty bottom coal and roof coal, which they should pick out, I go after the superintendent and he goes after his mine foreman and he goes after his miners to load cleaner coal. I watch two or three hundred tons of coal dumped from the mine cars and see how it is running, and if they do not have a man in the car to pick out the dirty coal, I go after the superintendent to put a man in the car to pick out what the miners miss. We all know that a miner cannot keep his coal thoroughly clean in a mine with safety lamps for light, and also the class of miners we have to deal with has to be watched very closely. I used to wonder why railroad companies did not have fuel inspectors years ago. They are buying millions of tons of coal every year and there are a great many tons of slate and dirty coal shipped which should have been picked out at the mine. Not long ago I was in a yard and from the cars as they came along I could pick out from 150 to 200 pounds of dirty coal. The proper attention was not given to the preparation of the coal at that mine or I would not have found the cars shipped in that condition. With the companies I represent we try to keep the coal up to the standard so there will not be any trouble. One of the very interesting points that ought to be looked after is the preparation of the coal for locomotives. If we get much of this dirty coal it runs high in ash and makes a good many clinkers in the engines and sometimes causes steam failures where if we had a good clean coal we would have no trouble in keeping up steam and avoid steam failures.

MR. J. C. WARNE: I would like to ask Mr. Wilson a question. Does smoke necessarily mean a waste of fuel? That may seem a foolish thing to ask, but I have heard expert opinion on both sides.

MR. WILSON: The dark cloud which is emitted from the smoke stack which we call smoke, is colored by particles of carbon from the unconsumed fuel. The smoke is an unmistakable evidence of waste of fuel from that source alone. There are, however, in addition, other sources of waste of which this discoloration is a signal. Smoke is a sign of incomplete and imperfect combustion. That means that there is being carried out of the stack with these particles of unconsumed carbon also a quantity of unconsumed gases. Through an anlysis of these gases it may be shown unmistakably that there has not been the proper mixture in the combustion chamber of oxygen and of fuel gases at the proper temperature.

There is also a further loss through the stack indicated by this black smoke. For not infrequently the temperature of the gases passing out of the stack is too high. This heat would have been absorbed by the water in the boiler tubes had there been the proper mixing and combustion within the furnace. Men who have made a practice of making flue gas analysis, not only of the gases but of the carbon in the flue, have proven unmistakably that there is a decided waste of fuel when smoke is produced.

MR. F. H. STARK: We as railroad representatives are directly interested in the cost of fuel. It would be interesting to learn from Mr. Wilson as to whether he is ready to explain to us in what manner he anticipates a larger percentage of the fuel may in the future be utilized. Whether the coal is to be converted into gas and through a gas engine generated into electricity as a substitute for power in connection with railroads or whether some other method will be evolved. He fully realizes that the design of our locomotives is such that fuel is used at a disadvantage. Does the author expect that much will be accomplished in the change of design of locomotives and the method of firing, etc., and thus consume a larger percentage of latent power in fuel in locomotive practice? These are two points that we would be glad to have Mr. Wilson enlarge upon.

MR. WILSON: The speaker has opened up a broad subject and one which would take a great deal more of your time to properly answer than you would desire that I occupy. The conversion of coal into producer gas and thence into electricity, is the first subject of which I will speak. The producer gas enthusiast—and there are many of them—will tell you that the evidence of tests shows that for a given type of coal its conversion into producer gas will convert more than double, 2½ times, the latent energy of that coal into useful work than could be done by its being burned under a steam boiler. That is an enormous saving, and one asks, therefore, why we do not use producer gas directly for our power generation instead of for steam. At once we meet many obstacles. To begin with, the operation of producer gas plants on a large scale and through large units is in its infancy. There are those who say that the time is not far distant when we will locate at the mines gas producer plants which will generate power from the cheapest kind of fuel. This fuel is not to be transported even one mile, but is to be used right at the mine, thus saving transportation charges. It is to be converted directly into producer gas and thence into electricity, which in turn may be transported two or three hundred miles, if necessary, in any direction to operate the railroads across the country, light our cities, etc. That may come about in time, but it will be a matter of very slow development. You all know that, economical as the producer gas generator may be in the first conversion of the coal into power, if one is going to convert it into electricity and transmit it long distances to operate trains, one begins to get heavy losses through the transmitting wires, the transformers and electric motors, etc., which must be balanced against gains by the conversion of fuel into power. These are operating and commercial problems which must be worked out slowly and gradually.

Now, as to the question of a larger portion of the latent fuel energy being converted by means of the steam boiler into power, there again the problem is not unlike that which I have just related for the gas producer. The development of the better appliances, the saving of more than the average 5% or 6%, is something which is not going to be brought about by a revolution. It is going to be a matter of very slow development, little changes by one man or another here and there. And those little changes are going on around us all the time. The most inefficient steam power producing plant is the small hand-fired boiler, of which we have vastly more numerically and actually in total power produced than we have in large installations, mechanically stoked and efficiently handled. In the former one has the inefficiency of the fireman, of the stoking methods, of the natural draft, etc., to contend with. And in the small hand-fired boiler, the small hoisting engines, derrick engines and stationary engines one sees everywhere, there is used perhaps only 4% or 5% of the latent fuel energy. As one progresses from that into the large stationary plants where there is installed the best mechanical stoking devices and where there is a well controlled artificial draft, one begins to get a much higher saving of fuel energy 8% or even 10%. And already in the most efficient plants, as I stated in my paper, citing the Chicago-Edison Co. and the great Interborough plant in New York, where they have the best type of engines and where large unit low pressure turbo-generators are used, they have added materially to the saving in latent fuel energy. They are now claiming to get 10% and even 11% and 12%, or almost as much as is obtained from the gas producer plant.

To revert to the gas producer plant, it can be used only under certain favorable conditions. In most power plants, certainly the majority of stationary power plants, one has not only power and light to furnish, but also heat in the winter time, and with the gas producer, if heat is to be provided, one must have some auxiliary heating arrangements. So it is often impracticable to attempt to introduce the gas producer.

PRESIDENT: Mr. A. G. Mitchell, of the Pennsylvania Railroad, is with us. Can we hear from him?

MR. A. G. MITCHELL: The one point in the paper which appeals most strongly to me as a railroad man is that a proper design of locomotives is necessary to get the best result from the fuel. If I understand this subject correctly, as it was presented tonight, certain fuels will give us the greatest heat units if consumed in certain designs of boilers.

Now, with a railroad trunk line extending across the continent, like the New York Central or the Pennsylvania lines, where each road has the same type of boiler on locomotives traveling over different sections of the country where they use coal from many mines, would it be possible with a standard design of locomotive and with different methods of firing, with these different qualities of coal which they consume, to get practically the same efficiency regardless of the quality of coal used?

MR. WILSON: I think you put the case very clearly as we see it, namely, that if one has a system of railways extending over a great distance and passing through territory where coal is available and is being used from various mines, I think it would not be very long ere the designers would begin to appreciate that it would be advantageous to them to have different type and arrangements of furnaces for the different types of coal available. If, on the other hand, the railroad could find it practicable to use one type of fuel for their whole system, then they could have one type of furnace developed suited to that particular type of fuel. I think undoubtedly it is true that in railroad practice as in stationary practice, for that matter, this question of thought for the fuel as well as thought for the machine, will have to be given attention, as is now being done a little in stationary practice. I have talked this over with a number of men who are well versed in fuel used on locomotives, including Professor Goss, of Urbana, who has given the matter a great deal of consideration in co-operation with our bureau, and Mr. H. J. Slifer, General Manager of the Chicago & Northwestern, who told me that as the result of the work we have been doing his attention was first attracted to this very fact and he is buying coal for that road according to the types of engine he has.

MR. A. STUCKI: The author said a little while ago that a gas engine proposition sometimes cannot be considered on account of the question of heating the building coming in. This reminds me of a paper read before this Club not long ago, wherein several arrangements of heaters were shown, using the exhaust of the gas engines as the heating medium, and bearing this in mind it does not look that the gas engines need be barred for such a reason.

I also would like to ask a question in regard to the economy of producer gas as a steam producer. It was said that it is 2½ times as economical as steam produced from coal and used in a high-speed engine. This result, however, is principally due to the use of an internal combustion engine, and I would now like to know what economy, if any, there would be in burning producer gas under a boiler, i. e., by the steam route. Sometimes we may have to consider this question when the natural gas becomes low or uncertain.

MR. WILSON: The question raised is a very interesting one, especially, as the speaker has stated, for those who are dependent upon natural gas. There is no reason why producer gas should not be used as a fuel. There is no reason why it should not be burned like natural gas to generate steam. So used, it is not put to the most economical and efficient use, however. Its greatest economy is by conversion directly into power by means of internal combustion engines. On the other hand, it can be used merely as a fuel, but with what relative efficiency has not yet been determined. We have been working on that problem. It is one very recently taken up and it has been worked on abroad, in Germany and Great Britain. As you all know, producer gas or what it is the practical equivalent, the waste gases from the by-product coke ovens and from blast furnaces is now being used to generate steam. It can, of course, be economically used there because it is a waste product. But when it comes to taking good coal and converting it into producer gas, the relative efficiency of burning that is indeterminate. The reason is that producer gas is very low in B. t. u., containing from about 110 to 160 B. t. u.'s, while natural gas contains about 1000 B. t. u. per cubic foot, and artificial gas about 650. Producer gas may be enriched thereby, burning with a hotter flame, but such a scheme is impracticable at the present time. Speaking of B. t. u.'s, reminds me of an incident cited by one of our coal inspectors in New England, in Boston, in fact. We have a great deal of difficulty in getting the coal contractors up there to bid on coal for the Government on the B. t. u. basis. It was necessary, therefore, that this inspector interview the various contractors and explain what B. t. u.'s were. Finally when he came to one of the contractors who had been in the coal business in the city for a great many years, and his father before him, and who knew he was handling the right kind of coal, answered, when our inspector said: "How many B. t. u.'s have you in your coal?" "Not a d—d one, sir; not a d—d one."

A VOICE: I would like to ask whether the Bureau of Mines has made any tests in fuel oils. I have had some experience with oil in open hearth furnaces and we have had two kinds of distillate that were claimed by several Pittsburgh oil men to be exactly the same oil, and in the open hearth furnace we got entirely different results from the two oils. I would like to know if it would be possible to find out the qualities of these oils by determining the B. t. u.'s.

MR. WILSON: That question was first put to us two years ago by the officers of the Rock Island Arsenal in connection with fuel oil purchased, and again shortly afterward in connection with the purchase of oil on contract for use at the Watertown Arsenal in the very type of furnace you speak of, open hearth, and for other metallurgical purposes. We determined the heat values of the different oils before hand and the final result showed so clearly that a certain oil which did not have the market there was superior to another which did, that we were asked to formulate specifications suited to fuel oil purchase on the B. t. u. basis similar to those we had already established for coal purchases. This has been done and has been in such favorable use by certain government purchasing offices for a year that it has been adopted at public buildings in Kansas City, San Francisco and elsewhere. Like other things which the government is doing, we are not in a position to tell informally just what these results are, because that might reflect on one product or another. Only as we have completed a series of tests and have published the results all together are we in a position to give the public the benefit as we are doing now for the government bureaus. We have now in progress of publication a small bulletin on specifications for fuel oil purchase on the B. t. u. basis, and if you will send your name to me I will see that you get a copy as soon as it is issued.

It may be interesting to add a little about these oil investigations. Like others they must be taken up in detail in some one place first, to learn ways and means. We started in California, because in that State there is a tremendously active producing field and the oil is particularly well fitted for and is in great demand for fuel purposes. We have oil specialists trained in the analysis of oils. These men are studying these fields, the occurrance and uses of the oils, and during the past two years have collected something over 500 samples from the different oil wells of California, making careful notes concerning each well, so that the history of each oil sample is authenticated. These samples are forwarded to our laboratory, where distillation tests, B. t. u. determinations and complete analyses and separations are made. In the course of the work we have had to develop processes of our own and have been working in harmony with the International Commission for testing petroleum products. This work is partially completed and will go to press shortly.

There is considerable difference in B. t. u. values in oils from California and Kansas, Pennsylvania and other States. Before long users of oil for fuel purposes will begin to consider these matters and will buy their oils on the B. t. u. basis. The vendors of petroleum products will also appreciate that as soon as the public knows that these materials are not merely oil, but are a number of things, it will be worth their while to try to use the Pennsylvania and California oils for the purposes for which they are each best suited.

MR. STUCKI: Touching upon the researches the government makes in the different oils to establish their respective heating values, is it not a fact that the public, when they want oil for power purposes, are only offered "Fuel Oil," which is a waste product left after the benzine, naphtha and other products have been extracted? If that is right, and my experience indicates that it is, then the people at large would not get the benefit of the government investigations.

MR. WILSON: Fuel oil is a distillate, a residuum oil, or a natural petroleum. When I spoke of fuel oil I did not mean the product which is commercially known by that name, but any petroleum product which is used for fuel purposes. There are many kinds and varieties.

MR. STARK: This has been a very interesting paper and yet I fear that it has been a little too deep for most of us. Some of our members, like Mr. Stafford and others who are qualified to discuss the question of fuel combustion, but for some reason or other they prefer to listen rather than talk. Then, too, many of our members that usually take part in our discussion are absent on account of the holiday season. As a rule at our Club meetings there are more that want to participate in the discussion than the time will allow. However, I am sure that Mr. Wilson's very able paper and subsequent remarks will prove fruitful, and I would move that we extend a vote of thanks to Mr. Wilson.

The motion was duly seconded and carried by unanimous vote.

PRESIDENT: Accept the thanks of the Club, Mr. Wilson. If there is nothing further a motion to adjourn will be in order.

ON MOTION, Adjourned.

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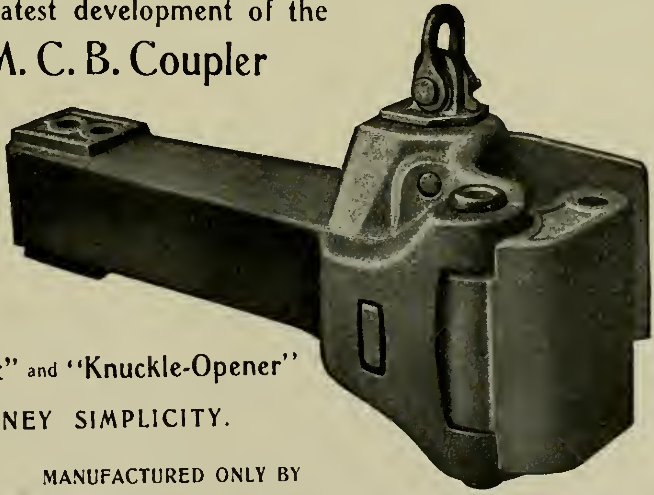

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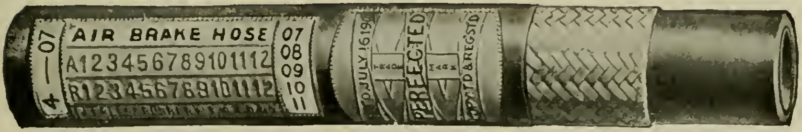

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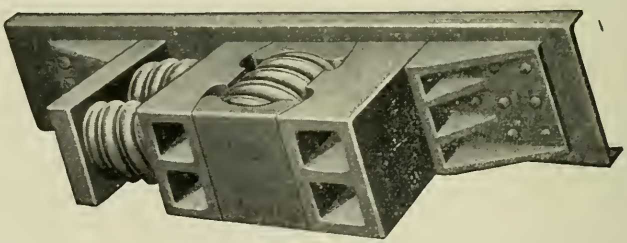

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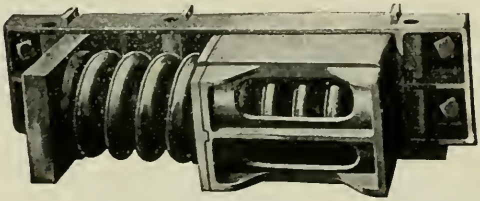

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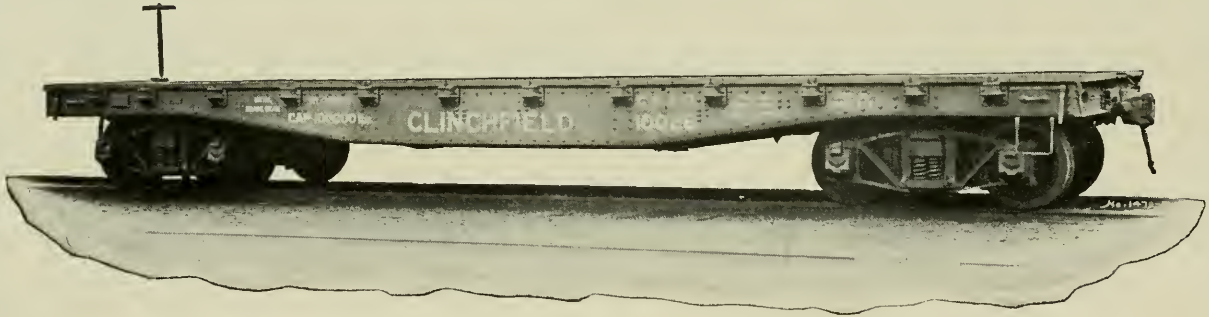

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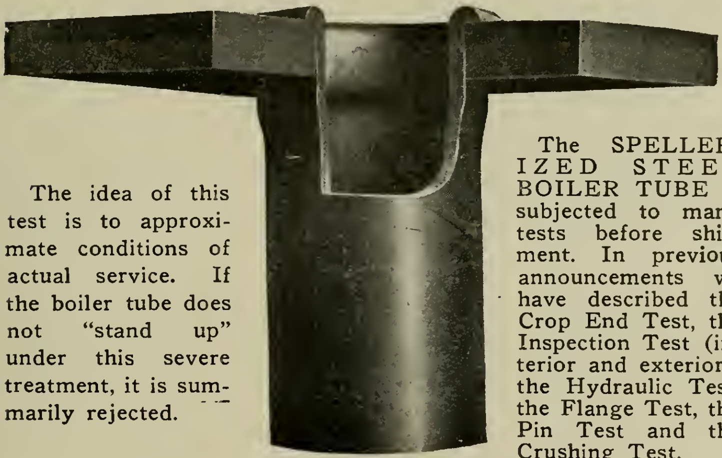

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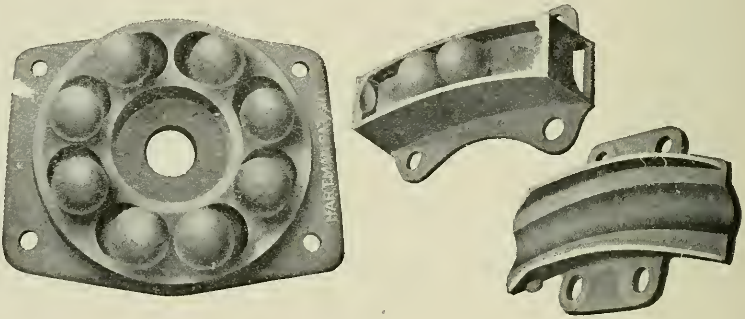

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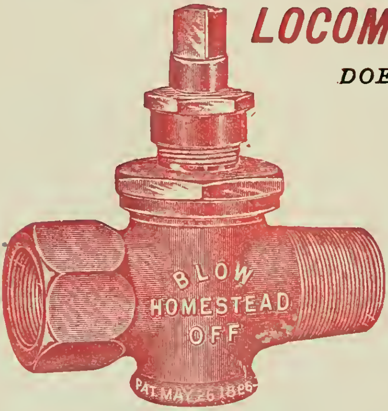

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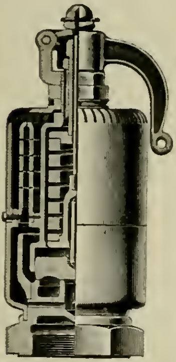

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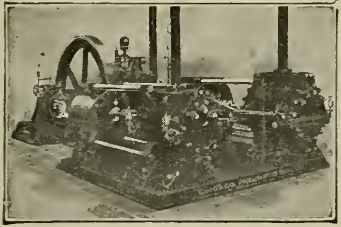

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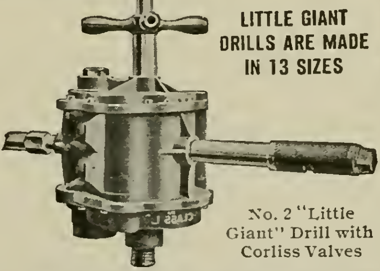

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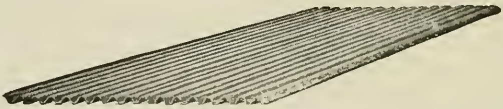

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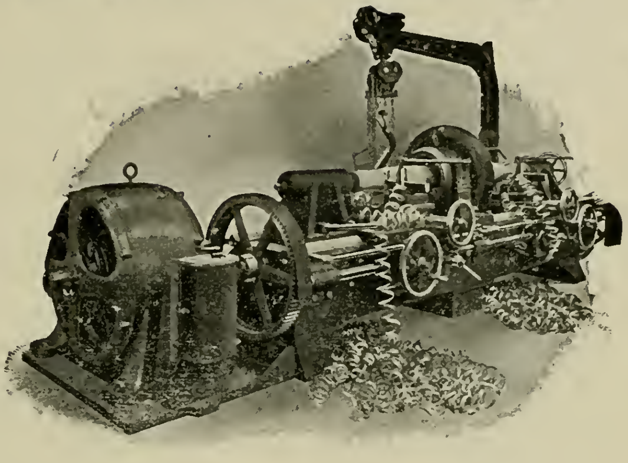

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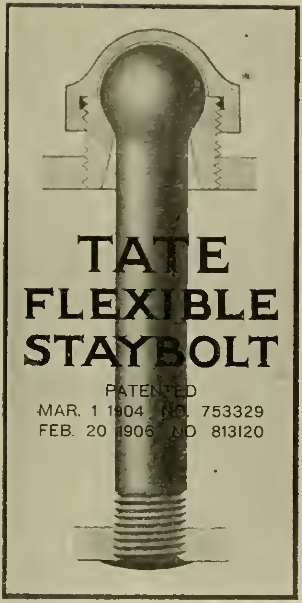

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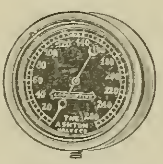

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INDEX—ADVERTISERS.

NAME	Page
American Brake Shoe & Foundry Co	iii
American Locomotive Company	viii
Ashton Valve Co	xi
Ball Chemical Co	ii
Brady Brass Co	Front Cover
Butler Drawbar Attachment Co	xviii
Chicago Pneumatic Tool Co	v
Clancy, J. R.	xvii
Cleveland City Forge & Iron Company	Front Cover
Crosby Steam Gage & Valve Co	v
Damascus Brake Beam Co	xvii
Dixon, Jos., Crucible Co	vi
Flannery Bolt Co	xi
Fort Pitt Malleable Iron Co	xii
Franklin Manufacturing Co	viii
Galena-Signal Oil Co	xii
Gold Car Heating & Lighting Co	vi
Gould Coupler Co	ii
Homestead Valve Mfg. Co	iv
Hunt-Spiller Mfg. Co	xi
Ingersoll-Rand Co	x
Lawrenceville Bronze Co	xv
Lino Paint Co	Back Cover
Long, Chas. R. Jr. Co	iii
Magnus Metal Company	vi
Manning, Maxwell & Moore	iii
McConway & Torley Company	xv
Nathan Manufacturing Co	iv
National Car Wheel Co	iii
National Malleable Castings Co	vi
National Tube Co	i
Niles-Bement Pond Co	ix
Page Woven Wire Fence Co	Front Cover
Peerless Rubber Mfg. Co	xvii
Pittsburgh Coal Co	iv
Pittsburgh Equipment Co	Back Cover
Pittsburgh Testing Laboratory	Front Cover
Pressed Steel Car Co	xx
Railway Steel Spring Co	xvi
Safety Car Heating & Lighting Co.	xvi
Sipe, James B. & Co	Front Cover
Standard Coupler Co	xix
Standard Steel Car Co	xviii
Steel Car Forge Co	Front Cover
Suydam, M. B. Co	Back Cover
Union Spring & Mfg. Co	xiv
Union Steel Casting Co	xix
Ward Equipment Co	xix
Washington Coal & Coke Co	ix
Western Railway Equip. Co.	Front Cover
Westinghouse Air Brake Co	vii
Westinghouse Electric & Mfg. Co.	vii
Westinghouse Machine Co	vii
Wood, Guilford S.	Front Cover

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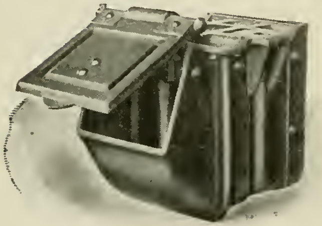

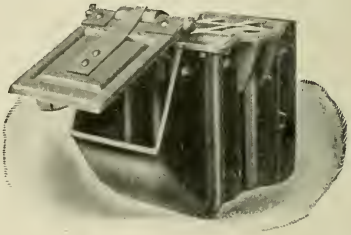

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of the

Railway Club *of* Pittsburgh.

ORGANIZED OCTOBER 18, 1901.

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Meetings held fourth Friday each month, except June, July and August.

PROCEEDINGS OF MEETING, JANUARY 27th, 1911.

The meeting was called to order at the Fort Pitt Hotel, Pittsburgh, Pa., at 8:00 o'clock P. M., with President F. R. McFeatters in the chair.

The following gentlemen registered:

MEMBERS.

Albree, Chester B.
Alleman, C. W.
Allison, John
Amsbary, D. H.
Anderson, J. B.
Ashley, F. B.
Barth, John W.
Bealor, B. G.
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Crawford, D. F.
Cullen, J. C.
Dobson, O. C.
Dunlevy, J. H.
Elmer, Wm.
Evans, H. E.
Fettinger, H. O.
Forsythe, Geo. B.
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Gies, Geo. E.
Gilg, Henry F.
Griswold, W. W.
Gutierrez, S. J.
Guy, W. A.
Hall, C. W.
Hamilton, Wm.
Hardman, H. J.
Harner, A. J.
Hauser, W. M.
Hay, Paul L.
Helm, E. E.
Hepburn, M. J.
Hoffstot, H. P.
Howe, D. M.
Hudson, W. L.
Hughes, J. E.
Irwin, Oliver
Jenney, Jacob
Kaup, H. E.
Kennedy, Jas.
Keptner, J. B.
Keyser, R. H.
Kinter, D. H.
Knight, E. A.
Koch, F.
Krause, Julius
Kurzhals, Chas. L.
Lewis, A. J.
Lockwood, B. D.
Long, R. M.
Lowe, W. D.
Macfarlane, W. E.
Mackenzie, R. H.
Malloy, M. A.
Mason, E. F.
Mason, F. N.
Mensch, E. M.
Millar, C. W.
Miller, F. L.
Mitchell, A. G.
Morse, R. C., Jr.
Murphy, W. J.
McDonnell, F. V.
McFeatters, F. R.
McIlwain, J. D.
McNaight, A. H.
McNulty, F. M.
Oates, Geo. M.
Orchard, Chas.
Parry, Wm. I.
Pechstein, Albert J. G.
Pfarr, Jacob

Pfeil, John
Phelps, W. H., Jr.
Porter, H. V.
Postlethwaite, C. E.
Proven, John
Publow, John J.
Pyle, P. S.
Rauch, T. T.
Reese, O. P.
Rinehart, H. W.
Robinson, S. R.
Rupp, R. D.
Ryan, W. F.
Scheck, H. G.
Shipe, Warren E.
Simpson, M. S.
Smith, A. D.
Smith, M. A.
Snow, Walter T.
Stucki, A.
Sullivan, W. H.
Summers, J. M.
Taylor, H. G.
Thomas, J. H.
Thomas, R. L.
Trout, W. L.
Unger, J. S.
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Smoot, W. D.
Stevenson, R. F.
Thornton, H. W.
Winters, J. W.
Young, C. D.

The reading of the minutes of the last meeting was dispensed with, they being in the hands of the printer.

The Secretary read the following list of applications for membership:

Bodie, C. W., Asst. Chief Clerk to Gen'l. Supt., B. & O. R. R. Co., Smithfield and Water Sts., Pittsburgh, Pa. Proposed by W. C. Drake.

Boyle, H. Edgar, Chief Clerk, Car Record Dept., Penna. Lines West of Pittsburgh, 1013 Penn Ave., Pittsburgh, Pa. Proposed by R. H. Keyser.

Brown, E. C., Chief Civil Engineer, Carnegie Steel Co., Carnegie Building, Pittsburgh, Pa. Proposed by F. R. McFeatters.

Buchanan, A. H., Chief Clerk, Tracing Dept., Penna. Lines West of Pittsburgh, 332 Mathilda St., Pittsburgh, Pa. Proposed by R. H. Keyser.

Cosgrove, Hugh, Foreman, Freight Shop, P. R. R. Co., Pitcairn, Pa. Proposed by J. F. Courson.

Crisfield, John W., Supt. Transportation, Carnegie Steel Co., Clairton, Pa. Proposed by F. R. McFeatters.

Davis, H. J., Supt., St. Clair Terminal R. R., Clairton, Allegheny Co., Pa. Proposed by F. R. McFeatters.

De Arment, John H., Foreman, Blacksmith Shop, P. R. R. Co., P. O. Box 284, Pitcairn, Pa. Proposed by J. F. Courson.

Doyle, A. J., Asst. Train Master, Monon. Div., P. R. R. Co., Pittsburgh, Pa. Proposed by M. A. Malloy.

Freshwater, F. H., Asst. Chief Draftsman, Pressed Steel Car Co., McKees Rocks, Pa. Proposed by A. Stucki.

Fitzpatrick, F. R., Asst. Engine House Foreman, Penna. Lines West of Pittsburg, 1100 Allegheny Ave., N. S., Pittsburgh, Pa. Proposed by F. Zinsmaster.

Glover, R. R., Secretary to Gen'l. Supt., B. & O. R. R., B. & O. Depot, Pittsburgh, Pa. Proposed by W. C. Drake.

Gumbes, J. H., Division Engineer, P. R. R. Co., Union Station, Pittsburgh, Pa. Proposed by M. A. Malloy.

Hammond, H. S., Sales Agent, Pressed Steel Car Co., Farmers Bank Building, Pittsburgh, Pa. Proposed by M. S. Simpson.

Jordan, James E., Piece Work Inspector, P. R. R. Co., 189 Mayflower St., E. E., Pittsburgh, Pa. Proposed by J. F. Courson.

Kewley, E. C., Asst. Supt., Pressed Steel Car Co., 506 Carolyn Ave., Bellevue, Pa. Proposed by H. E. Kaup.

Klingensmith, W. H., Foreman, Blacksmith Shop, P. R. R. Co., Thirty-second and Carson Sts., S. S., Pittsburgh, Pa. Proposed by M. A. Malloy.

Martin, W. H., Asst. Foreman, Freight Shop, P. R. R. Co., P. O. Box 114, Pitcairn, Pa. Proposed by J. F. Courson.

McConnell, P. L., Asst. Road Foreman of Engines, Allegheny Division, Penna. R. R. Co., 5206 Butler St., Pittsburgh, Pa. Proposed by A. Stucki.

McCully, John, Shop Clerk, P. R. R. Co., Verona, Pa. Proposed by E. M. Craig.

McDermitt, W. W., Chief Clerk to Gen'l. Foreman, P. R. R. Co., Pitcairn, Pa. Proposed by J. F. Courson.

McNaight, A. H., Reconsignment Clerk, Penna. Lines West of Pittsburgh, 846 Washington Ave., N. S., Pittsburgh, Pa. Proposed by R. H. Keyser.

Ralston, John A., Chief Inspector, Carnegie Steel Co., Carnegie Building, Pittsburgh, Pa. Proposed by F. R. McFeatters.

Riley, T. J., Engine House Foreman, Penna. R. R. Co., Forty-eighth St., Pittsburgh, Pa. Proposed by A. Stucki.

Sands, J. H., Master Plumber, P. R. R. Co., Thirty-second and Carson Sts., S. S., Pittsburgh, Pa. Proposed by M. A. Malloy.

Scott,, W. M., Train Dispatcher, P. & L. E. R. R., 625 Ivy St., E. E., Pittsburgh, Pa. Proposed by C. W. Alleman.

Steele, W. K., Chief Car Distributor, P. R. R. Co., Union Station, Pittsburgh, Pa. Proposed by J. B. Anderson.

Stevenson, R. F., Chief Clerk to Freight Agent, P. R. R. Co., College Ave., Oakmont, Pa. Proposed by E. M. Craig.

Thomas, E., Gen'l. Yard Master, Union R. R. Co., 810 Arlington Ave., McKeesport, Pa. Proposed by F. R. McFeatters.

Thornton, H. W., Supt., Penna. Lines West of Pittsburgh, New Castle, Pa. Proposed by L. C. Bihler.

Travis, J. H., Foreman Electrician, P. R. R. Co., Lock Box 5, Pitcairn, Pa. Proposed by J. F. Courson.

Voight, A. J., Asst. Foreman, P. R. R. Co., 55 South Seventh St., S. S., Pittsburgh, Pa. Proposed by M. A. Malloy.

Williams, C. P., Special Agent, Penna. Lines West of Pittsburgh, 1013 Penn Ave., Pittsburgh, Pa. Proposed by R. H. Keyser.

PRESIDENT: As soon as these names have been favorably passed upon by the Executive Committee the gentlemen will become members.

SECRETARY ALLEMAN: It is with deep regret that we have to announce the death of Mr. George P. Sweeley, on January 10th. The Club sent a floral tribute and we have a letter of acknowledgement from Mrs. Sweeley.

PRESIDENT: I will appoint as a committee to draft suitable memorial resolutions upon the death of Mr. Sweeley, Messrs. D. F. Crawford, D. M. Howe and L. H. Turner.

If there is no further business to come before the meeting, we will proceed with the paper of the evening, on "Some Aspects of the Railway of Today," which will be presented by Mr. H. W. Thornton, Superintendent, Pennsylvania Lines West of Pittsburgh, New Castle, Pa. I take pleasure in presenting to you Mr. Thornton.

MR. H. W. THORNTON: Mr. President and gentlemen of the Railway Club of Pittsburgh: I want to thank you for the honor you have conferred upon me in giving me this opportunity to appear before you. I say that now for two reasons. First, you are in an amiable frame of mind, which may not be the case later on, and, secondly, after the close of the paper it is not unlikely that my exit may be somewhat precipitous.

"SOME ASPECTS OF THE RAILWAY OF TODAY."

BY MR. H. W. THORNTON, SUPT., PENNA. LINES WEST OF PITTSBURGH, NEW CASTLE, PA.

Presumably, any sacrifice offered on the intellectual altar of this organization is expected to relate to our common profession, and, since candor forces a confession of inability to discuss intelligently any other subjects, I propose to inflict upon you what I fear may prove a very rambling address upon "Some of the Aspects ot the Railway of Today." I may also add that I have purposely selected a title which will permit me to ramble at will through the entire field of transportation without much chance of being brought to bay. To those who may have expected a highly technical discussion upon some one of the many details of railroad operation I can only say, by way of a balm to disappointment, that the art of transport has a historic and economic side, which is quite as important and interesting as the technique of the business, and which, in the engrossment of the moment, is often ignored.

We seldom appreciate the importance and significance of those accepted things of long duration with which we come into constant contact. The railway systems of this country and abroad, while of rapid development when marked through a period of years, have really grown gradually within the limits of individual vision; consequently, the part played by modern means of transportation, not only in the development of countries, but also in the manners, habits and social relations of mankind, is not at once apparent. No one thing has so materially affected the affairs of the human race as transportation. As Bacon says, "There be three things which make a nation great and prosperous: a fertile soil, busy workshops and easy conveyance of men and things from one place to another." Likewise, it has also been said, "Let us travel over the countries of the earth. Wherever there is no facility of passing from a town to a city, or from a village to a hamlet, there we may pronounce the people to be barbarians."

In a general way, it is evident that a means of transportation for both commodities and individuals is essential to the progress of civilization; but it is not so apparent that transportation, or rather its absence, has been a large factor in the evolution of races and nations. It is said that the human race originated from a common source, and that its cradle is somewhere in the highlands of Persia, whence it radiated to the four quarters of the globe. Springing from a common stock in prehistoric times, our earliest record of the human race reveals it divided into nations with different languages, customs and characteristics. That this development of nations and peoples from a common stock was unquestionably due to the absence of a ready means of intercommunication is beyond reasonable doubt; nor is it necessary to search the uncertain dawn of history for similar examples. Within more recent times, in this country, our forefathers penetrated the wilderness and established communities in the north, west and south. These communities were isolated from each other, with only occasional communication at long intervals; consequently, dialects of the mother tongue developed, different mental characteristics arose and, generally speaking, different views obtained with respect to many of the more important things of life. Climatic conditions and environment influenced the development of the individual and, consequently, we have the Southerner, Westerner and the Northerner. This was due, in a measure, to the lack of an easy means of communication and shows that the absence of transportation produces a marked effect even in a comparatively short time.

The earliest important means of transportation in the world's history was by water, and transportation by land was limited to such use as could be made of bridle paths or trails. The former, however, was hazardous and restricted to communities favorably located; but no attempt was made to develop a systematic means of inland communication until the time of the Roman Empire. The Romans undertook the construction of a system of highways, not for commercial reasons, but purely for military purposes.* Some of these roads exist today, a monument to the engineering ability of their constructors. There was established what was, for that time and in that age, an elaborate and effective system of communication between the capitol of the Empire and the provinces. Roads were built with unusual disregard for natural obstacles; swamps were drained, bridges built and hills leveled. In short, everything was subordinated to meet the military requirements of the Empire. This was the first attempt to provide a systematic means of intercommunication in Europe and, with the exception of occasional subsequent efforts, it is remarkable that nothing of the kind was conceived from that time until the day of Napoleon.

With the fall of the Roman Empire and the disintegration of Europe into a number of more or less hostile states, its highways fell into disuse and means of communication became rather undesirable than otherwise, for the reason that good roads aided invasion. With but few intervals, most of Europe was engaged in perpetual warfare with itself from the fall of the Roman Empire until after the Napoleonic wars. Commercial activity was largely limited or only existed insofar as it related to military affairs. With the disappearance of the Roman road system and during the dark or middle ages, transportation was driven to water, and, as a consequence, there is seen the increase in opulence of such maritime nations as the Venetians, the Genoese, and later the British, Dutch and Portuguese.

Within the sphere of its influence, which included nearly the entire civilized world, the Roman Empire acted as universal policeman and permitted only such disturbances of the peace as were started in its own interest; but after the fall of that State, most of the nations of Europe were engaged in an earnest and conscientious effort to appropriate as much of their neighbor's territory as possible. This industrious acquisitiveness existed, not only on the part of states, but also on the part of individuals, and the eighth commandment was kept more in its infraction than in its observance. Great barons regarded travelers through their possessions as legitimate prey. Robberies were committed with freedom and safety, and communication between countries was at the risk of theft or, at best, on the payment of tolls; hence, during this period, transportation by sea was practically the chief and only means of communication between countries.

The Crusades, fundamentally a religious movement, but ultimately degenerating into mere marauding expeditions, furnished the germ which added impetus to the exchange of products throughout the civilized world. The Crusaders became acquainted with the civilization of the Saracens and Oriental countries, for it is a fact that the Saracens of those days and the nations which are generally termed Mohammedan were further advanced in arts and science than those of Europe; consequently, the Crusaders became acquainted with the use and adaptability of products which were before unknown. For example, sugar was unknown in England prior to this period. This condition promoted a desire on the part of European nations for the luxuries of the

East, and there consequently developed an exchange of commodities.

From the latter half of the eighteenth century, road-making was pursued with activity and, in time, the construction of artificial water-ways or canals became general. The construction of artificial water-ways was fundamentally brought about by the superiority of that form of transportation in moving large bulks, but the discovery of steam as a motive power and the development of railways arrested its progress and turned the tide of transportation from water to land.

From the earliest times the construction and control of inland means of transportation has been regarded as a function of the government. This was primarily due to the fact that such means of communication were essential adjuncts of the military establishment. Highways were built by the State, over which individuals or companies, as the case might be, operated private vehicles and tolls were usually exacted for the maintenance of the roadway. It is but natural, therefore, that when railways were first conceived it was thought that the government should provide the way over which individuals and companies might operate their own cars, just as was the case on the highway. It was found, however, in the operation of a railway, that a certain harmonious relation had to exist in the movement of traffic; hence, it was impracticable for vehicles of independent ownership to pass over them at will, and, as a natural consequence, it came about that corporations were formed for the construction, equipment and operation of railways, but back of it all there was the feeling that the State must maintain some relation to such corporations and that they should be subject to governmental regulation, and this feeling has transmitted itself to our own land. When the great importance of railways was seen, in their effect upon the commercial development of the country, an additional argument for State regulation, if not government ownership, was furnished.

It cannot be denied that the trend is toward a closer and more exacting regulation of railways by the government, if not ownership. The conditions existing on the continent of Europe, where government ownership obtains to a greater degree than elsewhere, are frequently pointed to as a convincing argument, but the fact has been overlooked that government ownership presents stronger arguments in theory than in practice, and those nations of Europe which have assumed the ownership of their railroads were actuated by other reasons than the acceptance of the theory. In other words, the exigencies of the times were a potent factor in state ownership. For example, as Mr. W. M. Ackworth has pointed out, the Belgium railroads have always been the property of the State. They were built shortly after the separation of Holland and Belgium. At that time a system of railways was considered essential. Available capital was largely in Holland and, consequently, the construction of Belgium railroads by private capital meant the control of the former country, a thing to be dreaded; hence, there was no alternative but State construction and ownership. In the early days of railroads, Germany was not the integral empire of today. It was made up of a number of small states and principalities. These states were regarded as the personal property of the ruler; hence, it was only natural that the sovereign, through the machinery of the State, should undertake a monopoly of transportation facilities. In Australia, where government ownership, it is argued, has been most beneficial and advantageous, the railroads became the property of the State because the available capital of the country was absorbed in gold mining, and none could be found for other purposes. If a searching examination is made, similar reasons may be found in almost every instance where government ownership exists. In short, it is a fact that the reasons which primarily led to government ownership in foreign countries were the necessities of the time rather than any recognition of the theory involved.

In this country early environment and conditions molded national character. Our forefathers penetrated the wilderness, conquered hostile Indian tribes and carried forward the banner of civilization against almost unsurmountable obstacles. The contemplation of vast stretches of land, mountain peaks soaring to the sky, and all the glories of nature, instilled in the individual a spirit of freedom of thought and repugnance to control. Self-confidence became a habit of thought. No difficulty was too great to be overcome in the development of the country and, as the government was not in a position to finance a systematic means of transportation, it is only natural that it should have been undertaken by individuals. The conditions existing in this country and Europe were fundamentally dissimilar at the time railways made their appearance. Abroad, the avenues of commerce, to a large degree, were already established, and upon the construction of a railroad between two centers the interchange of products sprang at once to its maximum and only augmented thereafter as the general business of the country increased. In this country, however, railroads were built first to develop the country, and commerce and industrial activity followed in their train; hence, it is only natural that in a new country crying for development, and taking into consideration the national characteristics of its inhabitants and the absence of a military policy, railroads should not have fallen at once under government ownership and, furthermore, that there should have been but little, if any, real government regulation.

There is nothing new under the sun, and it is interesting to observe how history repeats itself. Dr. Lardner, writing in 1849, refers to the dissatisfaction existing in England at that time with the financial management of railways, and calls attention to the abuses of the day, which, in the main, are but little different from the criticisms which we have heard recently with respect to our own railway systems. With almost prophetic vision, he dwells upon the importance of honesty and publicity in the management of public utility corporations and closes his admirable work upon Railway Economy with these words: "In fine, considering the questions which have been agitated for some months regarding the great railway enterprises of the country, in all their bearings and relations, no expedient appears so likely to remedy the evils which have formed the subject of universal complaint and remonstrances, to revive public confidence and to restore railway property to its just value in the public market, as a system of publicity such as is here recommended." It is remarkable that this economist, writing sixty years ago, should have touched upon the very question which is now so prominent, and what is still more remarkable is, that such a warning should have escaped the attention for so many years.

American railways began in a small way and were made up of disintegrated lines scattered throughout the country. Concentration is but a natural consequence of the progress of the times.

It is found in nations, in commercial enterprises and in everything upon the face of the earth. It is logical, therefore, that consolidation should have made its appearance in railway affairs. In the march of years large combinations of transportation companies developed, and, today, a large percentage of our railways are either combined in one system or more or less centrally controlled. The same thing has come about in other fields of commercial activity and is the inevitable working out of a definite economic law. It is distinctly to the advantage of the public that such consolidations should not only take place, but should be fostered by the Federal Government rather than opposed. This is not repugnant to public welfare, provided the central government surrounds such consolidations and their operations with proper regulation. Competition has been said to be the life of trade. As a matter of fact, it is trade suicide, and many of our commercial evils can be directly attributed to its influence. Competition merely results in the survival of the fittest, and public welfare is better served by its elimination, under proper regulation, than by its existence. It is a well-known fact that this has been recognized in Germany, where the elimination of waste is encouraged by the formation of combinations of capital, but the German government has only permitted such combinations under proper supervision.

Acute competition was, in reality, responsible for the system of rebates which was practiced in this country until recently. This system was reluctantly entered upon by the railroads, for it is obvious that no railroad company would voluntarily reduce its income. The rebate system came to be generally accepted and, after it got into full swing, was quite anxiously fostered by the shippers as well. The evils of the system are too obvious to require comment and, after these evils reached an aggravated form, the railroads were quite as desirous to destroy the system as the government. Great difficulties were involved, however, and the only practicable solution, in the absence of legislative interference, seemed to be a participation in the weaker rate-cutting lines by the stronger systems, a practice not uncommon in general business. As a matter of fact, this paved the way and contributed quite as much towards the elimination of rebates as the activity of the government. As illustrative of the effect of extreme competition, it is fair to say that, if the rebate system had continued its course, the result would have been vastly detrimental not only to the railways but, likewise, to the industrial development of the country.

The advantages of railway consolidation having been proven, the spirit of combination developed with increasing strides, until the public awakened to the fact that it had all gone further without proper regulation than had been imagined. This fact, coupled with some questionable practices, inspired a distinct lack of public confidence and resulted in the immediate demand for correction. Unfortunately, the remedy was not carried on upon deliberate, scientific and economic lines. As a matter of fact, the situation was pounced upon by politicians, with the result that the corrective laws were by no means as wise and efficient as would have been the case under a more rational procedure. Common sense and a knowledge of political economy played a small part in the deliberations of legislative bodies. Reformers and so-called economic writers (for revenue only) joined in the chase, nor are they willing to abate the cry even after the first fruits of the reform movement have been realized. As Elbert Hubbard has said, "When God sent a current of common sense through the universe, most of the reformers wore rubber boots and stood on glass;" hence, it has come about that, from a well-founded desire to correct the evils of unregulated consolidation, a heterogeneous mass of regulation has been placed upon the statute books and the principles of political economy thrown to the winds, all of which has been further complicated by the efforts of the States and the Federal Government to accomplish an identical purpose. Rational and effective regulation will not be found until some way is hit upon to either eliminate the control of the States, or harmonize their efforts and those of the central government.

A good many reasons have been suggested to explain the present attitude of the public mind, not only towards railway consolidations, but toward other combinations as well. The importance of the functions of a railway and its close and intimate effect upon the daily life of the individual, renders its lapses of services especially prominent. This is perhaps aggravated by the attitude of the subordinate railroad functionary who comes into close contact with the public. The average American citizen is not mentally constituted to make a good servant. Every individual is as good and, usually, better than his neighbor; hence, there is not always manifested a spirit of conciliation. All of this, coupled with other things, furnishes the spark which starts the conflagration, but all of these reasons are rather subordinate to what I conceive to be the main cause, that is to say, lack of confidence on the part of the public in the administration of our large capitalistic combinations, which, in turn, has been followed by a feeling of fear that unless something was done, and done promptly, the country would find itself in the grasp of our large railway and commercial combinations. We have become an impulsive rather than a thoughtful and rational race. The demand for quick results is a national characteristic. Instead of composing ourselves and studying the question in a judicial and deliberate fashion, which could have been done without unnecessary or unreasonable procrastination, we sought an immediate solution, with the inevitable result. We are beginning, however, to look at the problem more intelligently and there is strong reason to believe that, while a good deal of unnecessary damage may have been done, the net result, in the last analysis, will not be disastrous.

It is idle to speculate upon the merits of Federal and State control of railways, because it is here and here to stay. In the judgment of every thoughtful person, it will increase; how far it will go depends entirely upon the wisdom and prudence of those charged with the administration of our great railway systems. Publicity, justice, consideration and conciliation will do more to arrest pernicious interference than vehement opposition. This does not necessarily involve a hysterical outburst of obsequiousnous, nor a pusillanimous surrender of rights. The thinking public is disposed to be fair, and, at any rate, under our system of government, that will obtain which the majority demands; hence, we shall first have to establish the justice of our case before the bar of public opinion. Any other procedure is futile.

The present aspect of the railway situation may lead to certain departures from established practices in matters relating to organization, as it has already in the details of operation. A small and comparatively compact railway is usually able to administer its affairs with greater economy and with much more satisfaction to the public than a very large system. This is because the officers of the smaller line come into closer personal contact with the public and more fully appreciate their difficulties and demands. Moreover, corrective action, when necessary, is quicker and more easily obtained. On our great railway systems the final conclusion with respect to any important question, be it a policy which affects the public locally, or the construction of some improvement which is badly needed, is determined by an officer located frequently some hundreds of miles from the scene and who is often overburdened with responsibility and work. A much greater efficiency would be secured and the public served more satisfactorily if there was more local authority and responsibility. On railroads operated under the divisional system this objection has been met in a degree, on some roads perhaps more than on others. When there is great density of traffic and important questions are a daily occurrence, there is a particular need for decentralization of authority. The problem is to gain all the advantages which come from centralization, and retain all which result from the smaller and more elastic organization.

The elimination of rebates, upon which the railroad of the past based its principal claim for patronage, has transferred, to a large degree, the solicitation of business from the traffic to the operating department. Formerly, a manufacturer shipped his freight over that road giving him the lowest rate, and service was generally a minor factor. If the service was poor, he charged it against the low rate, and the low rate generally got the business. In other words, a shipper submitted to inferior service, providing he got a sufficiently low rate to justify it, and he usually did. Today it is different. The rates over all lines are substantially the same, and the only way remaining to attract business to any road is service, efficiency, courteous treatment, and the qualities which any business house relies upon in establishing a market. This is as it should be, and these things are largely in the control of the operating department, and, therefore, I say that the operating department is a stronger soliciting arm of the service, under present conditions, than the traffic department, to which such functions are usually ascribed. Needless to say, this condition emphasizes the necessity of a complete and active spirit of co-operation and harmony betwen the two departments. This feeling no doubt exists on almost every railroad in a sense, but it will have to be very much more intimate in the future to meet changed conditions.

In this connection, I am of the opinion that on our large railroad systems, at least, where there is great density of traffic, should be districted in accordance with geographical and traffic conditions. A manager should be placed in entire charge of each district. This officer should be solely and exclusively responsible for everything, of any character whatsoever, which relates to the business of his company in his territory, traffic, operation and otherwise. His staff should consist of a chief mechanical officer, a chief engineering officer, a superintendent of transportation, who should be charged with the handling of the business, or the operations of the conducting transportation department; also, a superintendent of traffic, who should be charged with the details of all matters relating to what we now term the traffic department; a chief counsel, to advise with respect to legal matters, and such other staff officers as a suitable representation of subordinate departments may require. The manager should report to the general manager with respect to operating matters, and to the freight traffic manager with respect to traffic matters. There need be no complication from such an arrangement, for, under a purely divisional organization, the division engineer reporting to the superintendent is also under the supervision of the chief engineer, and the master mechanic is likewise under the control of the superintendent of motive power. Under this organization the two most important arms of the service, the traffic and operating departments, would necessarily have to pull together, because they would be under the direction of the same officer. Important questions involving outside individuals and corporations could be answered promptly and authoritatively, and the operations of the whole system thoroughly amalgamated and, consequently, more efficiently conducted. There is a further advantage in that the general manager, or chief operating officer, and the freight traffic manager would be able to devote their superior abilities to the origination and execution of really important policies and methods. The criticism that is at once advanced is the difficulty in finding officers to fill the position of manager who would be equally competent to administer the operating and commercial features of the business. I cannot but regard this as a detail, for the development of a system which has produced as many brilliant minds as our American railways certainly should find no unsurmountable obstacle in educating men to fill such a position as I have described. The point of fundamental importance is that there is secured the advantages of both centralization and decentralization.

After all, the higher railroad officer of the future can no longer be exclusively a skillful traffic officer, a brilliant engineer, or an ingenious operating man. He will have to be all of these in a degree; an analyst primarily, and with ability to appreciate the full effects of such movements as we have passed through, the economic side of the problem, and to foresee the future. There must be a call for men of better general education, men of studious and scholarly habits of mind and judicial tendencies of thought. The day of the railroad officer who follows precedent merely because it is such, and is complacent in established practice, or who dwells within the narrow confines of the department in which he was educated, is past. Generally speaking, there are five cardinal points in the administration of every railroad property:

1. The net earnings.
2. The maintenance of property.
3. The development of the property to meet the demands of increasing business.
4. The relations of the company to the public.
5. The relations of the company to its employes.

And all of these are of equal importance.

The trend of future railway regulation will relate more to rates and financing than to the details of operation. There is already a pretty complete regulation of matters affecting the safety and comfort of employes and the traveling public. As yet, there has been no deep invasion of the financial field, but we are approaching it and are already well into the rate question. There seems to be a growing feeling, if the utterances of shippers and others who oppose advances in rates are sincere and to be taken seriously, that under a fair capitalization only the current per cent of interest is to be allowed on bonds and not much to exceed 6% on stock, with but little, if any, further margin, and rates are to be determined on this basis. If this is to be the final conclusion which is to govern legislation, we are pretty close to government ownership, and, at least, face to face with government partnership. Given government control of bonded indebtedness, definite limitations to stock dividends, and an adjustment of rates on this basis, the inevitable consequence is either universal bankruptcy or the government must assume the responsibility of providing capital for railway development and must guarantee interest on bonds and dividends on stock, which would necessarily carry with it a federal voice in the direct administration of railways and, likewise, the compulsory arbitration of labor disputes (the obligation to protect our transportation lines from the constantly increasing demands of the unions for additional compensation). Whether such an arrangement will provide merely a halting place preparatory to total absorption, or furnish a permanent and satisfactory solution of the whole question, is debatable. Indeed, the whole problem is a very serious one and we are rapidly drifting to the most important crisis which has faced the American people since the secession of the South. It is not possible within the scope of this paper to discuss this aspect of the situation, for its intelligent treatment would involve much more time than is at my disposal, to say nothing of your patience. I merely want to point out where we are drifting and that the people of this country will have to do more calm, rational and disinterested thinking than they have been called upon to do for many years, if a workable solution is to be reached.

Both sides of the question have been vociferously advanced and I have endeavored, in this discussion, to maintain a rational and unprejudiced position. There is a good deal, however, to be said in behalf of the railways. To begin with, the rapidity of the development of our country along commercial and industrial lines, as well as others perhaps, is unprecedented in the history of the world. In the decade ending 1890 there were constructed 70,000 miles of railroad in this country, and, as an eminent economist has put it, "This marvelous achievement is unprecedented in the economic history of any other country in the world." It is inconceivable that the general growth of the country could have proceeded with such rapidity if the principal means for the exchange of commodities was merely a tax upon the nation, feasting upon its fat and gorging itself with extortionate profits wrung from the manufacturer, a throttle upon development and a millstone about the neck of prosperity. I have pointed out some of the things which the railways may have to do, but there is a burden also on the public. First, we must come to a thorough realization that politics and advertisements for political purposes must be absolutely eliminated from the deliberations of our legislative bodies. Economic questions will have to be submitted to the calm deliberation of scientific men who are properly equipped to deal with the subject. A hopeful sign of the times is the proposed Tariff Commission, but before a complete realization of the benefits from such rational methods can be reached there must be a material change in the attitude of the public mind with respect to the methods of corrective procedure, and, as a first step, the compensation (security in office) of public servants and those engaged in the administration of the affairs of the government and its various regulatory bodies must be increased to command the services of the best talent in the country. As a matter of fact, the average public servant is outrageously underpaid, and important positions are often held by those who are incompetent to fill a position of like responsibility in any private corporation. If this can be brought about and politics eliminated from the legislative bodies which control our economic policy, we can contemplate the final result with equanimity.

PRESIDENT: We would like to hear some comments on the paper. Mr. Bihler, can we hear from you?

MR. L. C. BIHLER: Mr. President and Members—principally Members—I want to make a confession. Three weeks ago your honored and good-natured President told me Mr. Thornton was going to talk and asked me to "come out and form part of the audience and follow your usual tactics by throwing bricks at what he would say." I told your President I did not think I could throw bricks at anything Mr. Thornton said, because I knew Mr. Thornton too well, and I am convinced that I "told it right" to the President. You will notice that he "remembered his invitation" and called on me first, having in mind this "brick throwing," and he reminded me again of it tonight as I came in the door.

Mr. Thornton has given us a very interesting paper this evening. He has gone "away back" to the Roman times. There was one little omission. He did not mention "Traffic Manager Noah," who had a large cargo to move, with a limited amount of equipment.

Mr. Thornton referred in one part of his paper to "co-operation." As I know him, and as a good many other officials of our company and other companies with whom the Pennsylvania Lines West do business know him, he practices what he preaches. In Pittsburgh, something like four years ago, he delivered a discourse on "co-operation." He practiced it before he delivered that speech and he has been practicing it ever since, consequently I know he is absolutely sincere in what he has said this evening.

A great many people overlook the real definition of the word co-operation. I do not pretend to remember the meaning of all the words in the dictionary, but I think co-operation is defined by Noah Webster something like this: "To work with one another." A good many people either forget about that word "with," or they take a midnight axe and they clout it out.

Mr. Thornton also has some very novel ideas about up-to-date railroading, introducing the co-operative features into the case, by having a traffic official, and an operating official, both about on the same level work "double team"—work *together*—co-operate. Another point which he touched on which I think is very important, in a large sense the local officials do not have the authority, and I do not think I am entirely wrong in making the suggestion that sometimes you have to go through a very intricate red tape mill to get an important point decided one way or the other.

This talk is not a criticism, Mr. Thornton and members; it is simply an endorsement of what Mr. Thornton has suggested. I haven't any criticism to offer.

PRESIDENT: Mr. Stucki is going to read a paper before the Engineers' Society at an early meeting on a similar subject, and he ought to have something of interest to say.

MR. A. STUCKI: I can only assure you that I am very sorry that I ever promised to read a paper on that subject, because I could not do any better than just read Mr. Thornton's paper over again, and I am sure it would be better appreciated than my own.

I may say that I will treat the subject more from a mechanical standpoint and I trust I shall not infringe on the limits of Mr. Thornton's paper seriously. So I will ask to be excused from discussing the subject tonight.

PRESIDENT: Mr. Mitchell, have you anything to add?

MR. A. G. MITCHELL: Mr. Chairman, I do not know that I can say anything except that I appreciated the paper very much as it was read. I might emphasize possibly what has been brought out that the time is coming, or is here already, when, as our friend (?) Brandeis, of Boston, says, it is scientific management which will be required and that it is service which will hereafter be demanded as the only inducement to shippers to ship by certain lines, a close intimate association and interest in the welfare of the shippers so that they will, through such service, give their business to these lines, that is, they will give the business to the lines that will afford them the best service.

PRESIDENT: Are there any others who would like to speak on the question? Mr. Crawford, it is a good while since you have been with us; we would like to hear from you.

MR. D. F. CRAWFORD: I have not been here for so long that I have very little to say, but that little is all in approbation of what Mr. Thornton has said in his paper. It admits of very little discussion, as there is but one side to it, and two sides are necessary to produce discussion. I have been very much interested in it and approve heartily in all he has said, both as to government regulation—with which I have been rather too familiar in the last few years—and the development of the railroads in the future. I believe fully that increased efficiency is desirable, but not printer's ink on paper, but rather brass tacks.

PRESIDENT: Mr. Postlethwaite?

MR. C. E. POSTLETHWAITE: I agree with Mr. Crawford that there are really not two sides to that paper. Of course, there is Mr. Bihler's comment that he could have rambled back to Noah, and that is a good proposition, too. But taking it all into consideration, the increased efficiency, as Mr. Crawford has said, increased efficiency is the thing today, and there is only one way to accomplish that and that is for everybody to work shoulder to shoulder. They must do it, and the combination of the different departments is sure to work good.

I can remember in my own experience in the transportation line when some question would come up and they would say, "We do not have to bother about that, that is a traffic department matter." Now, you will have somebody around who keeps you together and it is bound to increase the efficiency where we need it.

PRESIDENT: Mr. Albree, would you express your views on the subject?

MR. CHESTER B. ALBREE: Mr. President and Gentlemen:—I am not a railroad man at all. At the same time I have the honor of meing a member of this Society. But I speak from the point of view of a shipper, a very small shipper. There are two or three things that have struck me in the paper this evening. One of them is that from a railroad man, it is a great pleasure to a shipper to know that the railroad man wants to do the square thing.

The other speaker mentioned an early transportation manager named Noah. Noah was in the transportation business with two of a kind. Among them were certain carnivorous animals. And one of the questions that has always puzzled me is, how, when he made a six or eight or ten weeks' trip, he managed to get along with his lions without anything for them to eat, for there were only two of a kind and they all had to last.

Leaving that aside, what I want to say is, that, speaking as a shipper, and I have never had anything to do with the railroad business otherwise, except, as occasion offered to sell them, when I could convince them, or by some means induce them, to think that we were the lowest bidders, all the shipper wants is a fair deal. I do not care if the freight rate to Oregon is $5 a hundred, or $2 a hundred, or 50c a hundred, provided it is just the same to everybody, in other words that it is a square deal. There was a paper read before the Chamber of Commerce, a copy of which

I received, showing, acording to this man's representations, that the railroads did not give Pittsburghers a square deal, and he gave instances. Whether those are correct or not I am not prepared to say, but I am prepared to say that I think there ought to be a square deal.

Now, to illustrate, leaving the freight department and going for the time being to the passenger end. Last spring I had occasion to go up to Saegertown. Coming down one day on the train there was a gentleman on the Pullman talking with several others there, and he said: "Have you occasion to go to Saegertown often, or to Cambridge Springs?" We said occasionally. He said, "All you have to do is to buy a ticket to Meadville and then pay your cash fare from Meadville to Saegertown or Cambridge Springs, and you will save 75c over buying a ticket through." We all thought that was rather a funny arrangement, and we asked him why. "Well," he said, "Meadville is a competing point." Now, gentlemen, there is something to consider.

MR. THORNTON: Referring to the gentleman who goes to Meadville, the trouble is he went the wrong way. If he would just buy a ticket to Linesville and take the elegant service provided by the trolley company from there to Meadville and thence to Cambridge Springs he could have probably beaten even that 75c. Linesville, I may say, is on my division.

PRESIDENT: Mr. Unger, can we hear from you?

MR. J. S. UNGER: Mr. President and members, I am in the same position as Mr. Albree; I am not a railroad man. Mr. Thornton in the beginning of his paper said that the subject was of rather a rambling nature, and at first I thought he was going to treat it in that way, but later I decided that he had treated it in a very inelligent, entertaining and interesting manner. You who visited the World's Fair in Chicago in 1893 will recall the legend that was over the main entrance of the Transportation building: "Of all human inventions those which have been of the greatest benefit to mankind have been those which annihilate distance." This was announced many years ago. It has been true since mankind has existed. I believe the subject has but one side and the paper, coming as it does from a railroad man, seems to be a criterion of the idea that is pervading the minds of the people at the present time. It does not have two sides, therefore it does not permit of much discussion.

I am reminded of a story. A college professor was examining some students in mathematics. There was one young man who had very little to say. The professor said to him: "Young man, you have studied mathematics somewhat?" "Yes, I have." "How many sides has a circle?" "Two." Somewhat surprised, the professor said: "How do you make that out?" "It has an inside and an outside." The professor did not know exactly how to reply to that, so he said: "You have also studied moral philosophy?" "Yes, a little." "So you know of a case in which effect has preceded cause?" "Yes, I do." "Please give us an example." "A man wheeling a wheelbarrow."

MR. BIHLER: If there is no further discussion I would like to move that this body express its appreciation of Mr. Thornton's very interesting paper by a rising vote of thanks.

The motion was seconded and carried unanimously.

There being no further business,

ON MOTION, Adjourned.

In Memoriam.

GEORGE P. SWEELEY

Mr. George P. Sweeley was born in Montoursville, Penna., July 13, 1856; died at his home, Bellevue, Penna., January 10, 1911, and was buried in Highwood Cemetery, Allegheny, Penna.. He leaves a widow, one daughter (married) and two sons.

He received his education in Montoursville, Penna., public schools and commercial college, Williamsport, Penna., and at the age of eighteen entered the Renovo, Pa., shops of the Pennsylvania Lines East of Pittsburgh, as machinist's apprentice. On March 1, 1883, he was appointed machine shop foreman in the Indianapolis, Ind., shops of the C., St. L. & P. Ry., and held successively positions as general foreman, Indianapolis, Ind., and Columbus, Ohio, shops of the Southwest System, and master mechanic of the Crestline, Ohio, Wellsville, Ohio, and Allegheny, Penna., shops of the Northwest System of the Pennsylvania Lines West of Pittsburgh, making a continuous service in the Pennsylvania System of almost twenty-eight years.

Mr. Sweeley was an excellent mechanic and shopman and was faithful and loyal in the discharge of his duties. His death is deeply regretted by every one who knew him and particularly his associates and subordinates in the various positions he occupied; his genial and kindly nature according him universal respect and esteem.

Copy of these resolutions be presented to the family of Mr. Sweeley and also be spread upon the minutes of the Railway Club of Pittsburgh.

D. F. CRAWFORD,
D. M. HOWE,
L. H. TURNER,
Committee.

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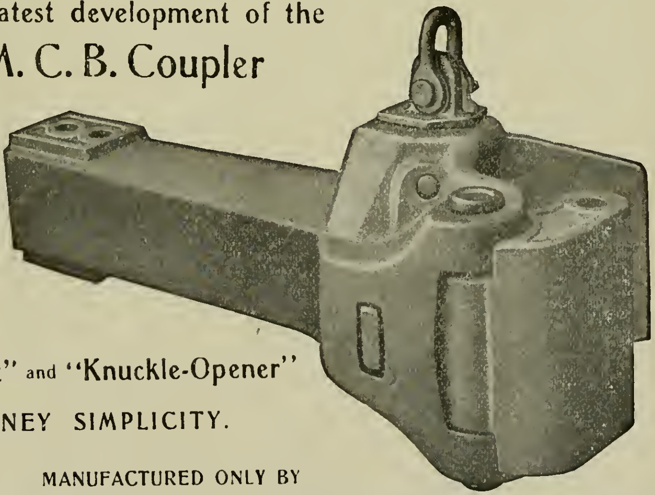

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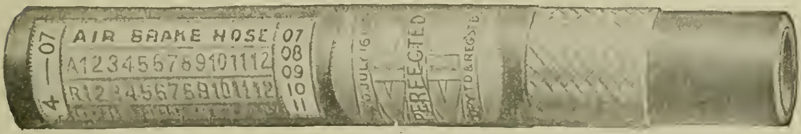

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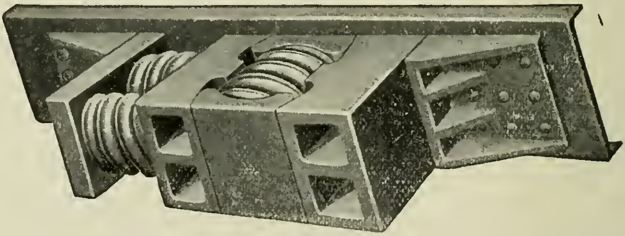

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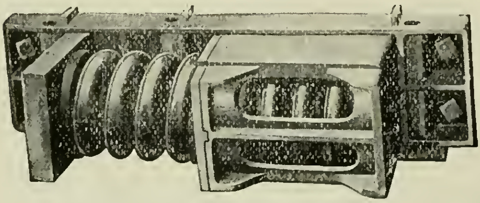

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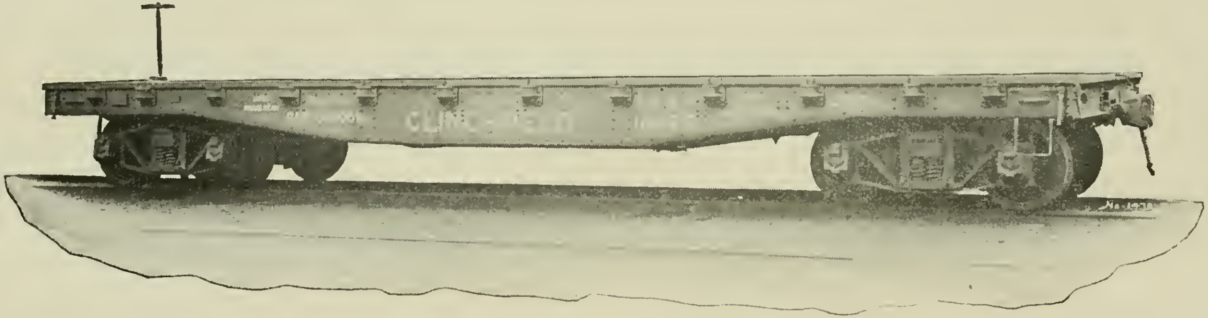

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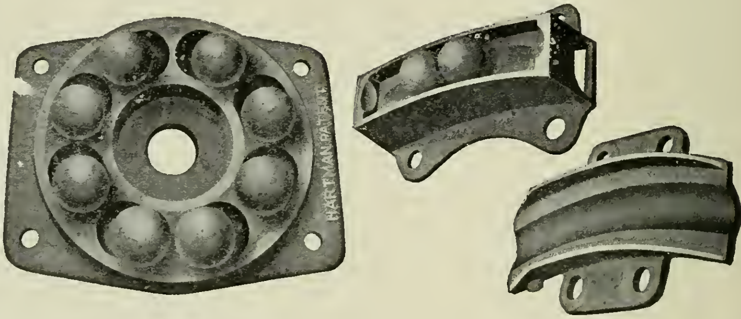

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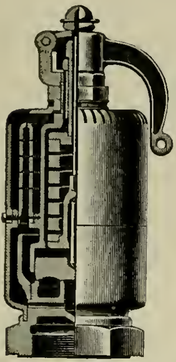

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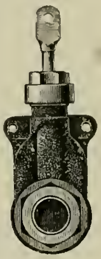

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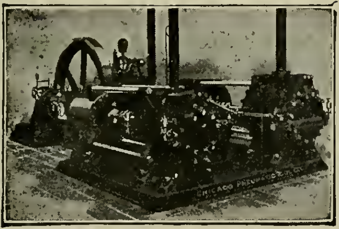

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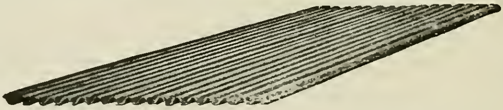

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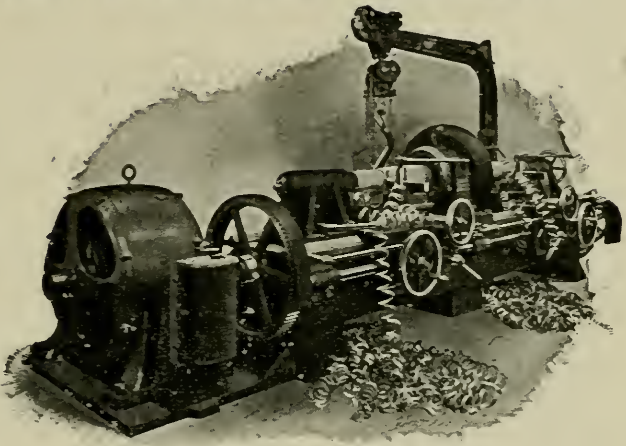

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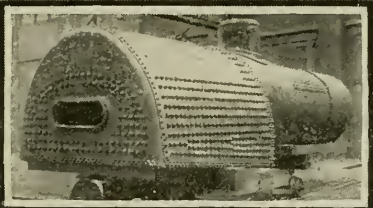

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INDEX—ADVERTISERS.

NAME	Page
American Brake Shoe & Foundry Co	iii
American Locomotive Company	viii
Ashton Valve Co	xi
Ball Chemical Co	ii
Brady Brass Co	Front Cover
Butler Drawbar Attachment Co	xviii
Chicago Pneumatic Tool Co	v
Clancy, J. R.	xvii
Cleveland City Forge & Iron Company	Front Cover
Crosby Steam Gage & Valve Co	v
Damascus Brake Beam Co	xvii
Dixon, Jos., Crucible Co	vi
Flannery Bolt Co	xi
Fort Pitt Malleable Iron Co	xii
Franklin Manufacturing Co	viii
Galena-Signal Oil Co	xii
Gold Car Heating & Lighting Co	vi
Gould Coupler Co	ii
Gray-Thurber Automatic Train Control and Signal Co. of America	x
Homestead Valve Mfg. Co	iv
Hunt-Spiller Mfg. Co	xi
Ingersoll-Rand Co	x
Lawrenceville Bronze Co	xv
Lino Paint Co	Back Cover
Long, Chas. R. Jr. Co	iii
Magnus Metal Company	vi
Manning, Maxwell & Moore	iii
McConway & Torley Company	xv
Nathan Manufacturing Co	iv
National Car Wheel Co	iii
National Malleable Castings Co	vi
National Tube Co	i
Niles-Bement Pond Co	ix
Page Woven Wire Fence Co	Front Cover
Peerless Rubber Mfg. Co	xvii
Pittsburgh Coal Co	iv
Pittsburgh Equipment Co	Back Cover
Pittsburgh Testing Laboratory	Front Cover
Pressed Steel Car Co	xx
Railway Steel Spring Co	xvi
Safety Car Heating & Lighting Co.	xvi
Sipe, James B. & Co	Front Cover
Standard Coupler Co	xix
Standard Steel Car Co	xviii
Steel Car Forge Co	Front Cover
Suydam, M. B. Co	Back Cover
Union Spring & Mfg. Co	xiv
Union Steel Casting Co	xix
Ward Equipment Co	xix
Washington Coal & Coke Co	ix
Western Railway Equip. Co.	Front Cover
Westinghouse Air Brake Co	vii
Westinghouse Electric & Mfg. Co.	vii
Westinghouse Machine Co	vii
Wood, Guilford S	Front Cover

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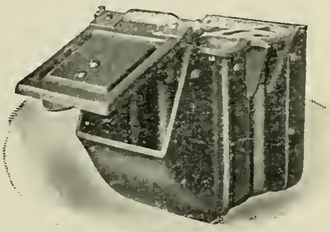

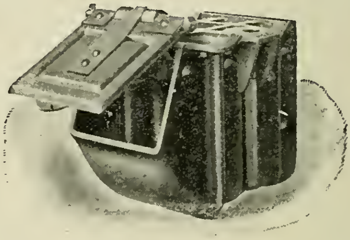

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Meetings held fourth Friday each month, except June, July and August.

PROCEEDINGS OF MEETING, FEBRUARY 24th, 1911.

The meeting was called to order at the Fort Pitt Hotel, Pittsburgh, Pa., at 8:00 o'clock P. M., with President F. R. McFeatters in the chair.

The following gentlemen registered.

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Grewe, H. F.
Griswold, W. W.
Grove, E. M.
Gutierrez, S. J.
Guy, W. A.
Harner, A. J.
Hench, N. M.
Hoffstot, H. P.
Horriman, H. A.
Howe, D. M.
Hudson, W. L.
Hunter, H. S.
Hyndman, F. T.
Jordan, James E.
Kennedy, Jas.
Keptner, J. B.
Kinter, D. H.
Kissinger, C. F.
Knickerbocker, A. C.
Knight, E. A.
Koch, Felix
Krause, Julius
Lanning, C. S.
Lanning, J. Frank
Lobez, P. L.
Lockwood, B. D.
Lowe, W. D.
Lybarger, J. H.
Malloy, M. A.
Mason, E. F.
Mason, F. N.
Mason, Stephen C.
Matthews, John A.
Mensch, E. M.
Millar, C. W.
Mitchell, A. G.

Montgomery, H.
Morse, R. C., Jr.
Mowry, Jas. G.
McConnell, P. L.
McDonnell, F. V.
McFeatters, F. R.
McGrory, Percy
McIlwain, J. D.
McMaster, R. T.
McNaight, A. H.
McNulty, F. M.
Neilson, Allan
O'Connor, M.
Orchard, Chas.
Orner, Milton T. S.
Pechstein, Albert J. G.
Pfarr, Jacob
Porter, H. V.
Publow, John J.
Rabold, Wm. E.
Ralston, John A.
Redding, D. J.
Richardson, C. A.
Riley, T. J.
Rinehart, H. W.
Robinson, J. R.
Rupp, R. D.
Ryan, W. F.
Sampson, J. M.
Sargent, L. L.
Sargeant, Wm. A.
Schauer, A. J.
Scheck, H. G.
Schomberg, W. T.
Schultz, Geo. H.
Scott, W. M.
Shannon, Chas.
Slemmer, W. M.
Smith, D. M.
Smith, Russell
Stark, F. H.
Stark, J. L.
Stewart, S. R. B.
Suhrie, N.
Sullivan, W. H.
Symington, C. J.
Tate, Ralph H.
Thomas, J. H.
Travis, J. H.
Trout, W. L.
Voight, A. J.
Walker, J. W.
Walther, G. C.
Warfel, J. A.
Warfield, J. M.
Warne, J. C.
Weckler, H. L.
Weisbrod, J. F.
Wescoe, F. B.
White, F. L.
Williams, C. P.
Williams, W. W.
Wood, Ralph C.
Wood, W. B.
Woodworth, R. B.
Young, W. W.
Zimmerman, E. W.

VISITORS.

Abell, Van J.
Ague, Fred.
Ash, Chas. M.
Aurandt, E. S.
Battenhouse, J.
Brodhead, Richard H.
Conway, S. M.
Clifferd, M. J.
Collis, A.
Cox, Shelby
Demmler, E. W.
Dudley, G. W.
Ellis, Frank J.
Furman, John A.
Farrell, Thos.
Fisher, A. W.
Frame, R. S., Jr.
Freeble, T. M.
Gilbert, Alex. D.
Graham, W. J.
Gray, G. B.
Gray, W. C.

Grove, Jos. P.
Hardesty, I. L.
Harrington, C. O.
Havekolb, Edw.
Haynes, J. E.
Henry, A. S.
Henry, W. A.
Hettler, R. C.
Holbrook, W. H.
Hollien, Wm.
Mackert, A. W.
Marshall, J. H.
Martin, R. H.
McCready, Harold
McGuire, A. A.
Orbin, Geo. N.
Patterson, H. E.
Reed, W. Edgar
Rice, A. L.
Robinson, D. M.
Roth, Reinhardt
Sadd, L. C.
Schlick, H. H.
Shaw, L. P.
Short, W. A. D.
Shremp, J. A.
Simons, Leonard
Smith, A. C.
Smith, D. W.
Smith, Sion B.
Snyder, W. H.
Stewart, Albert
Stewart, Raymond E.
Thurber, Guy P.
Weaverling, J. H.
Weiss, W. .W
Wiles, G. R.
Woods, Edwin S.
Wryke, J. W.
Yawman, C. A.
Young, C. D.

The reading of the minutes of the last meeting was dispensed with, they being in the hands of the printer.

The Secretary read the following applications for membership:

Bretz, F. K., General Manager, Morgantown & Kingwood R. R., Morgantown, W. Va. Proposed by A. Stucki.

Cahill, M. H., Train Master, B. & O. R. R., B. & O. Depot, Pittsburgh, Pa. Proposed by John J. Publow.

Collins, C. R., Assistant Shop Clerk, Penn'a. R. R. Co., Twenty-eighth St. and Liberty Ave., Pittsburgh, Pa. Proposed by H. W. Rinehart.

Gillooly, J. J., Assistant Chief Shipper, Carnegie Steel Co., Schoen Steel Wheel Works, McKees Rocks, Pa. Proposed by F. J. Black.

Hurley, P. W., Assistant Round House Foreman, B. & O. R. R., 5633 Second Ave, Pittsburgh, Pa. Proposed by John J. Publow.

Kelly, H. B., Traveling Fireman, P. & L. E. R. R. Co., 904 Page St., McKees Rocks, Pa. Proposed by D. J. Redding.

Long, A. T., Clerk, Train Dispatcher's Office, Penna. R. R., 715 Anderson St., Pittsburgh, Pa. Proposed by R. H. Mackenzie.

Mason, Allan B., Store Keeper, Monongahela Connecting R. R. Co., 4166 Second Ave., Pittsburgh, Pa. Proposed by F. M. McNulty.

McGaughey, Chas., Store Keeper, P. R. R. Co., 1022 Franklin Ave., Wilkinsburg, Pa. Proposed by H. W. Rinehart.

Neilson, Allan, Chief Clerk, Car Record Office, Penna. Company, 1366 Montezuma St., Pittsburgh, Pa. Proposed by A. H. McNaight.

Pickels, H. D., Assistant Chief Clerk to General Manager, Monongahela Connecting R. R., Second Ave. and Bates St., Pittsburgh, Pa. Proposed by F. M. McNulty.

Rice, D. S., Boiler Shop Foreman, Penna. R. R. Co., Twenty-eighth St. Shops, Pittsburgh, Pa. Proposed by H. W. Rinehart.

Sadd, L. C., Secretary, T. H. Nevin Co., Pittsburgh, Pa. Proposed by S. C. Mason.

Schauer, A. J., Assistant Train Master, Monongahela Division, P. R. R. Co., 237 Rochelle St., S. S., Pittsburgh, Pa. Proposed by A. G. Mitchell.

Worthington, W. R., Fire Marshal, Penna. R. R. Co., Union Station, Pittsburgh, Pa. Proposed by H. W. Rinehart.

PRESIDENT: As soon as these applications have been favorably passed upon by the Executive Committee, the gentlemen will become members.

If there is no further business, I will present to you Mr. Guy P. Thurber, who will read the paper of the evening.

THE CONSERVATION OF HUMAN LIFE IN STEAM AND ELECTRIC RAILROAD TRAVEL.

BY MR. GUY P. THURBER, CO-INVENTOR OF THE GRAY-THURBER SYSTEM OF AUTOMATIC TRAIN CONTROL AND CAB SIGNAL, PITTSBURGH.

It is a well known fact that the railroads of this country are doing all in their power to adopt and install the most modern equipment of safety devices for the protection of life and property.

Up to the present time the best known protection for handling the trains with their intricate and complicated traffic conditions is by means of interlocking and automatic block signal systems, which use the semaphore blade by day and the light by night to indicate to the engineer the condition of the block ahead—and whether it is safe for him to proceed or not.

One can readily understand that the eye of the engineer must observe the signal, while through the brain the hand must act, and any failure on the part of this operation places in jeopardy not only many precious lives, but fortunes in property.

In other words, the human element is there, and as long as we are obliged to depend upon it, we shall be unable to prevent the many frightful wrecks and accidents which have occurred so frequently that the National Government and the public press are clamoring against the terrible slaughter going on around us.

This fact has become so apparent that not only are the traveling public demanding something to be done, but the railroad officials themselves are looking for some established system of automatic train control to overcome this weak point in their safety signal system, and thus not only protect their own property and that for which they are responsible, but to give their patrons the greatest possible protection when traveling on their railroads.

For your information, I wish to call attention to a few figures given in the official bulletin of the Interstate Commerce Commission for three years ending with their fiscal year, June 30th, 1909.

I have taken collisions only, which might have been avoided had an automatic train control system been in operation.

Collisions for the Year Ending June 30th, 1909:

Year	Number of Collisions	Loss in Dollars	Persons Killed	Persons Injured
1907	8,026	$ 6,299,568	776	9,541
1908	6,363	4,635,199	414	7,712
1909	4,411	3,108,691	342	5,395
	18,800	$14,043,458	1532	22,648

Mr. W. L. Park, General Superintendent of the Union Pacific Railway Company, in a paper read before the New York and New England Association of Railway Surgeons, at the Academy of Medicine, in New York City, November 16, 1910, said that one human being was killed every hour and one injured every ten minutes on the American railroads.

Mr. E. F. Schneider, General Manager of the Cleveland Southwestern & Columbus Railway, in an address before the convention of the Central Electric Association, at Toledo, Ohio, May 26th, 1910, said that negligence of employees is the cause of 85% of the railroad accidents occurring in the United States, and 13% due to negligence of the public, while only 2% to hidden defects or the acts of God.

He further states: "We can no longer tolerate them from a moral standpoint, because we owe a duty to our fellow-men and we can no longer see them suffer as they have in the past. We cannot tolerate them from a financial standpoint, because they have become so burdensome that we are tottering under the load. 'We do too much fighting and too little thinking.' If we had spent half the money preventing what we did fighting, our accident account would not be so great."

These constantly increasing railway accidents within the last ten years, resulting as they do in horrible deaths and life-long injuries, have attracted the special attention of the general public, to such an extent that National legislation was secured in the matter of steam railroad operations, and a great many States of the Union have created State Railroad Commissions, with authority to exercise jurisdiction over interstate railroad and interurban electric traction operations.

Quoting a few passages from one of Pittsburgh's daily papers on the subject, it says:

"With *characteristic indifference,* the great American public has been more interested in the *growing speed of locomotives* than in the *lives that have been crushed out* through carelessness and neglect."

"Business men have been far more taken up with the Interstate Commerce Commission's actions in cases applying to *freight rates,* than to the steady endeavor to *stop the slaughter* that was fast becoming one of the greatest national disgraces."

"Along with the growth of transportation facilities has come a corresponding increase in the veritable *army* of men, women and children who are doomed to suffer *more* than the *miseries of death,* because of the shameless *neglect* of those *whose duty it is to safeguard them.*"

"The *giant* locomotives and the *endless* trains they draw, have grown to be instruments of *torture and devastators of homes.*"

"A great *army of maimed* and *shattered* human beings could be organized from the *victims* of *'man's inhumanity to man.'* "

"To such an *appalling* extent has the casualty list grown that *one* trainman in *eight* is wounded every *year.*"

By a careful examination of the official report, compiled by the Interstate Commerce Commission, we find that during the ten years preceding the present, i. e., from 1900 to 1910, 95,643 were killed and 923,615 persons were injured on American railways.

As against this number: During the Civil War in the Union army, 67,058 men were killed in battle.

The last six years of *peace,* therefore, have been about as *deadly* on the railways as four years of rebel bullets.

In justice to the railroads, however, I should add that after the smoke of battle had died away, 43,012 other soldiers died from their wounds, bringing up the total of those lost directly in battle to 110,070.

Even this, however, is only about 15,000 more than were killed on the nation's railways in the last ten years.

And, perhaps, if it could be determined how many of that vast army of 923,615 persons who were hurt or maimed by the railroads and afterwards suffered death, the railway casualty list would exceed that of the Union army.

These figures are so startling as to be beyond comprehension, and yet there they are in tell-tale figures of black on white, as compiled from the Interstate Commerce Commission's official reports.

Year	No. Killed	No. Injured
1900	7,865	50,320
1901	8,455	53,339
1902	8,588	64,662
1903	9,840	76,553
1904	10,046	84,155
1905	9,703	86,008
1906	10,618	97,706
1907	11,618	111,016
1908	10,188	104,230
1909	8,722	195,626
	95,643	923,615

Now, let us suppose that all those killed (95,643) were put out of their misery *immediately*, which was far from being the case, then let us *attempt* to imagine the sufferings of the more than two-thirds of a million people (923,615) who were crushed, scalded, burned, banged about in battered-up cars and broken almost into bits, and a chill of horror comes over us at the thought.

When you have pictured to yourself these harrowing wreck scenes, try to realize what has for several *decades* stood in the way of *improvements* that will eventually wipe out this unnecessary suffering and incidentally *save* many more dollars than the *improvements* cost by *avoiding* the *paying out* of such tremendous sums as are devoted each year to the *settlement* of *damage claims*.

Right here it is most appropriate to mention the *huge sums* paid out for damage of property and injury of persons in the totals reported by the Interstate Commerce Commission.

The New York Central lines lead the personal injury list with $1,530,801 for the year ending June 30, 1908.

With pecuniary damage to property of $3,098,796. And expenses for "clearing" wrecks of $375,479.

As against this the expenses of the Pennsylvania system are reported to have been $897,004 for "personal injuries," $1,854,888 for damages to "freight" and $776,535 for clearing wrecks.

While the " 'Frisco" system cost $1,264,501 by injury to "persons" and $2,110,945 by damage to freight.

It only needs a rapid mental calculation to sum up the average yearly loss to all the railroad companies based upon the figures of only the three just mentioned, to justify one in concluding that a large expenditure to avoid these accidents would prove a profitable financial investment to the railroad corporations.

An analysis of the Interstate Commerce Commission reports show that the factors, which go to make the grand total of $1,000,000,000 a year of railroad expenses, of which Louis Brandeis, representing the shippers, contended 30% could be saved, are roughly as follows: Loss and damage caused by wrecks, 25%; maintenance of structures and way, including cost of rails, ties, ballast, bridge repair and upkeep of buildings and grounds, 30%; labor, 12%; fuel, 17.3%; depreciation of equipment and administration expenses, pensions, law, clerical services and insurance, 15.7%. Total, 100%.

The grand total of $250,000,000, which comes under the head of wrecks and damages to property, is made up of the following items:

Transportation—	
Injuries to persons	$ 15,000,000
Damage to freight	25,000,000
Damage to property	2,000,000
Clearing wrecks	4,000,000
Maintenance of Equipment—	
Freight cars, renewals	7,000,000
Freight cars, repairs	94,000,000
Passenger cars, repairs and renewals	23,000,000
Locomotive repairs	80,000,000
Total	$250,000,000

In addition to the charges reported to the Interstate Commerce Commission for renewals and for repairs of cars on each road for wrecks, there should be added the depreciation totals of all, which amount to $20,000,000 for freight train depreciation and $5,000,000 for passenger train depreciation. If it were not for wrecks these depreciation totals of $25,000,000 would cover all the loss of the roads in the accounts for "freight and passenger transportation." If the depreciation be added to the total charged to wrecks, it would bring the grand total of waste up to $71,000,000.

The cost of operating block signals, as reported to the Interstate Commerce Commission for the year ending June 30, 1907, was $7,000,000. In addition to this there was expenditure for maintenance. But if the total for block signal systems was $10,000,000, it is evident that the railways were the gainers. But if the signal equipment could do no more than flash red and white lights, which engineers may fail to see or fail to obey, and if the same operation that flashes danger signals would also, if needs be, bring the train to a halt, it is evident that a saving to the railroads would be an enormous sum and go far toward making up the 30% which Mr. Brandeis contended is wasted of the total operating cost of $1,000,000,000 a year.

Right here I would like to quote a few excerpts from the Block Signal and Train Control Board's report of the Insterstate Commerce Commission, just issued, in which they say:

"The Board has considered that as block signals, both automatic and non-automatic, have already been intelligently developed in this country, particular attention should be devoted to the automatic stop, which has not been so fully developed. Collisions resulting from the weaknesses in the time-interval or train-dispatching system, and the deficiencies in the block system, due to untrained or undisciplined signalmen, as well as errors on the part of the enginemen and trainmen, have led to a public demand for automatic devices, for it is a well-known fact that many accidents have been caused by the failure of enginemen to observe, understand and obey signal indications.

Failures to observe signals may be due to fog, snow, signal light not burning, or smoke from other trains; failure to under-

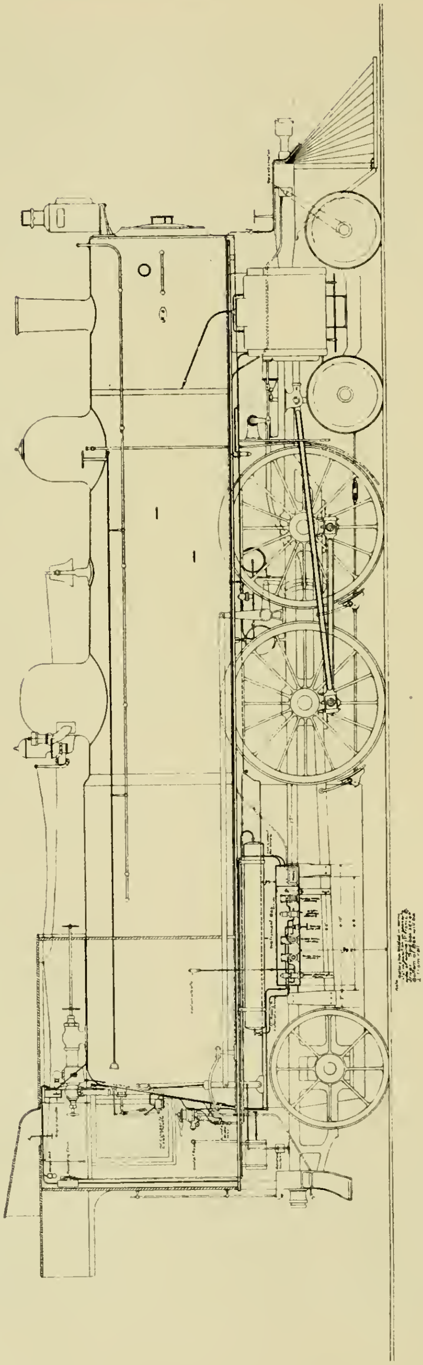


Figure 1—Side View of Locomotive, Showing Instruments.

stand or comprehend the signal may be due to complexity in the system of indications, or to diversion of the engineman's attention, or to his physical incapacity. Failure to obey indications that are seen and comprehended are rare, and comprise only those cases where enginemen desiring to make time are tempted to take chances, or to a too liberal interpretation of rules which allow the enginemen some discretion."

Tonight I shall endeavor to show you a system of train control which has been designed to fill this long-felt want, and which has passed the inspection and approval of many of America's best signal engineers, as well as the United States Government experts, and can be applied to both steam and electric or interurban railroads.

Some of you will remember a trial demonstration made on the Pennsylvania Railroad west of Allegheny, during the year of 1905, to prove out the principle of automatically controlling trains successfully by using the well-known principle of the electro-automatic block signal, which had been previously accepted and adopted as a standard of the safest protection to life and property then known to the art.

This trial was in actual service on two local passenger locomotives for several months, on which daily reports were made to the officers of the Pennsylvania Railroad Company, and the result proved everything which was claimed for it at the time, and can easily be verified by the Pennsylvania Railroad officials.

In order that you can more easily comprehend the practical operation of the Gray-Thurber system, I will first call attention to Figure 1, which shows a side view of an E-2 or Atlantic type locomotive, such as used on the Pennsylvania Railroad.

It will be seen that, attached to the frame work of the engine just beneath the high-pressure air reservoir, and located directly under the engineer's seat in the cab, is an iron box, which is normally under lock and key, but the cover has been removed in order to show the most of the instruments in their respective positions, assembled and connected up to the pipe lines leading from the high-pressure air reservoir, and also to the different valves in the cab of the locomotive which are used to control the train.

The air cylinder which controls the throttle is attached to the boiler head, in close proximity to the throttle lever; while connected in the train line, directly below the engineer's brake valve, is a special automatic brake valve, which is used by our system to control the brakes.

Above the steam gauges and in front of the engineer, is where the visual signal indicator is located. The audible signals, such as the caution whistle and danger bell, are placed not far from the engineer, one at his side and the other over his head, and each gives the warning and designates the kind of a signal that has been transmitted into the cab.

A contact key, which enables the engineer to take control of the train after it has been stopped, is placed within easy reach of his seat, as shown in the drawing.

Besides the above instruments located in the cab, there is a recording clock, which is fastened to the back-board of the cab and is under lock and key, so that no one but the inspector can open and have access to the records.

The instrument box above referred to has a relay in one end and assembled in the other compartment are two magnet valves with their time valves, and also a cut-out valve, each of which will be described in detail a little farther on.

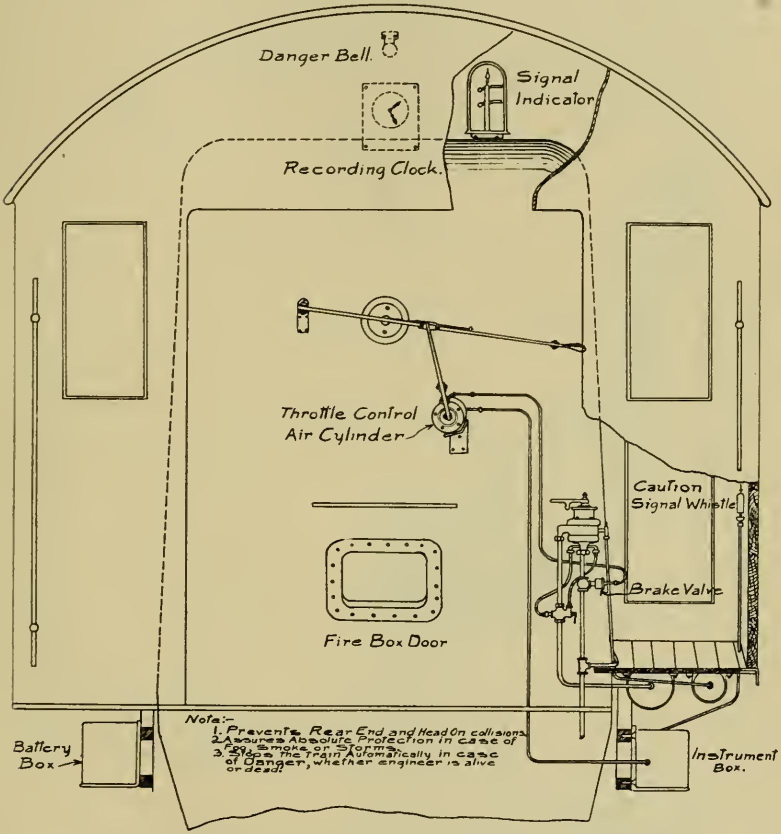
The wiring is all carried through iron conduit, and thus protected against external injury.

All the electrical appliances are controlled by closed circuits, which is the fundamental principle of the system, and, therefore, any injury to the equipment or circuits, either electrically or mechanically, will immediately be detected by the signals given and the stopping of the train.

A battery reversing switch fastened to the frame work on the outside of the engine, below the engineer's seat, and mechanically connected to the engineer's reversing lever, controls the polarity of the cab batteries in reference to the direction in which the engine is traveling, and thus assures the proper polarity of the cab circuit used in conjunction with the track circuits when the engine is in motion.

On the opposite side, under the fireman's seat, in the same relative position as the instrument box, is located the box that carries a duplicate set of storage batteries which supply the necessary current for controlling the relay and other instruments.

On the bumper beam of the pilot is attached the speedometer, which is connected to the front pony truck wheels, and this instrument is used to prevent the stopping of the train automatically whenever it is moving less than five miles an hour, or some other designated speed; also to avoid a second application of the air and stopping of a train that has been stopped back of an automatic signal found at danger.



Note:–
1. Prevents Rear End and Head On collisions
2. Assures Absolute Protection in case of Fog, Smoke or Storms.
3. Stops the Train Automatically in case of Danger, whether engineer is alive or dead.

Figure 2—Interior View of Cab, Showing Instruments.

In Figure 2 we have a view of the interior of the cab looking toward the end of the boiler. Part of the frame-work is cut away in order to give a better view of the cab equipment in its proper relation with the other appliances of the engine.

In this view one can more readily trace the pipe connections between the instrument box and the throttle air cylinder, and also between said cylinder and the special automatic brake valve.

We also get a better view of the signal indicator in its proper location in front of the engineer, as well as the proper relative positions of the recording clock, danger bell, caution whistle, and battery box, all of which will enable one to more readily grasp the operation that takes place in the cab when an automatic signal has been received.

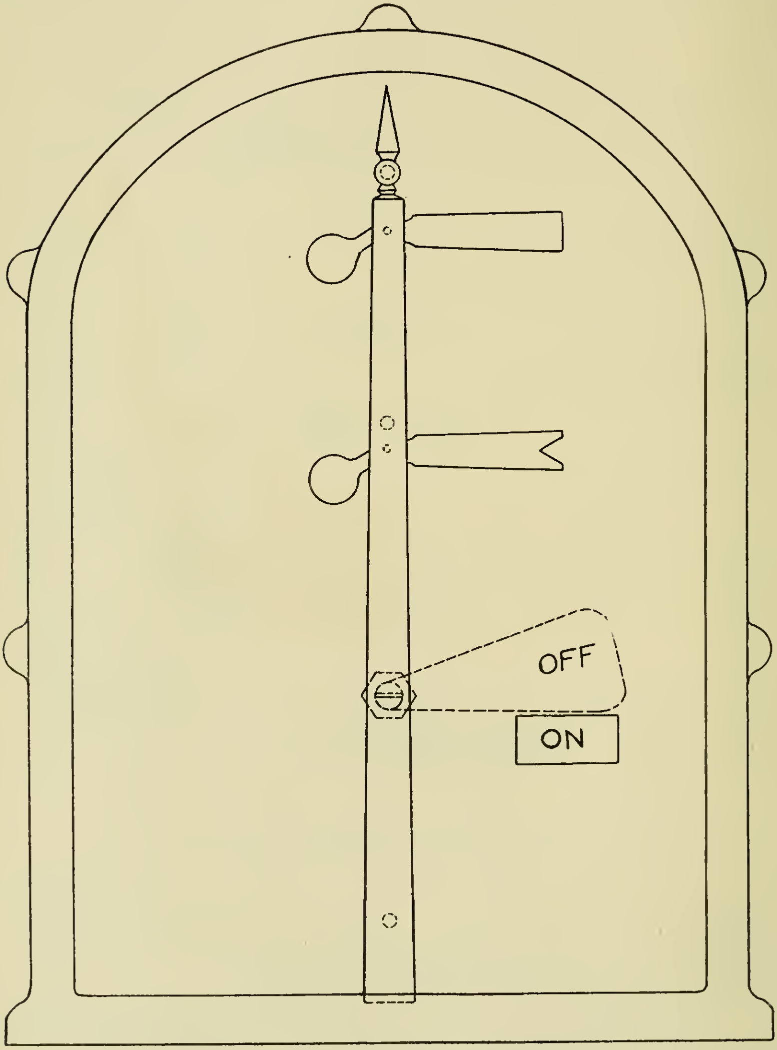


Figure 3—Face of Signal Indicator.

Figure 3 shows a front view of the signal indicator above mentioned. It will be seen that three different kinds of indications are given. The two semaphore blades designate the caution and danger signals in precisely the same way as the regular automatic block signals located along the right of way.

The little fan-shaped shutter marked "on" and "off" is electrically connected to the cut-out valve located in the instrument box, and designates to the engineer whenever said valve is opened or closed. If open, the air is "on," and the train can be automatically controlled. If closed, the air is "off," and the safe operation of the train is at the mercy of the engineer.

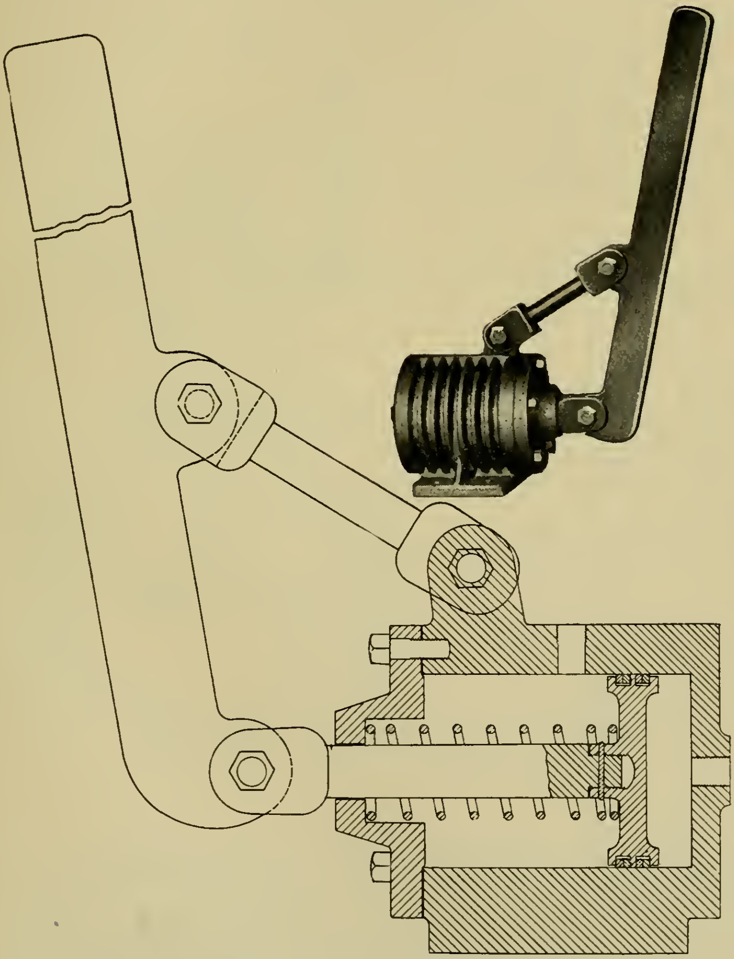


Figure 4 "A"—View of Throttle Controlling Cylinder.
Figure 4 "B"—Cross Section of Same.

Figure 4 "A" is a view of the throttle-controlling cylinder, showing the lever that closes the throttle when the air is admitted.

A cross section of same Figure 4 "B" shows in detail the piston which responds to the air when admitted through the port at the rear end of the cylinder, and also the port which is uncovered by the piston when shoved forward, thus allowing the air to pass to the brake valve as soon as the throttle is closed. The spring in front of the piston forces the lever to release the throttle as soon as the air is exhausted from the cylinder.

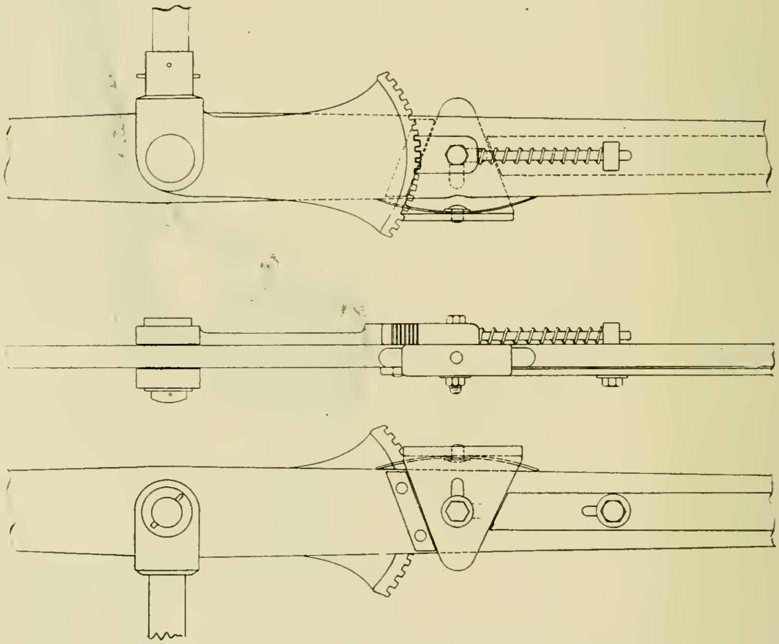


Figure 5—Releasing Latch on Throttle Lever.

Figure 5 shows the latch device in its proper position on the throttle lever, and on account of its wedge-shaped construction it is easy to see how the latch of the engineer's lever is raised and the throttle closed whenever the arm of the cylinder moves back to engage it. A leaf spring behind the wedge disengages it from the latch as soon as released by the automatic arm.

In Figure 6 we have several views of the special automatic brake-valve previously mentioned, and which was shown located in the train line just below the engineer's brake valve. By noticing the cross-section view "A" it will be seen to be a piston type of valve and operated in the same way as the one controlling the throttle.

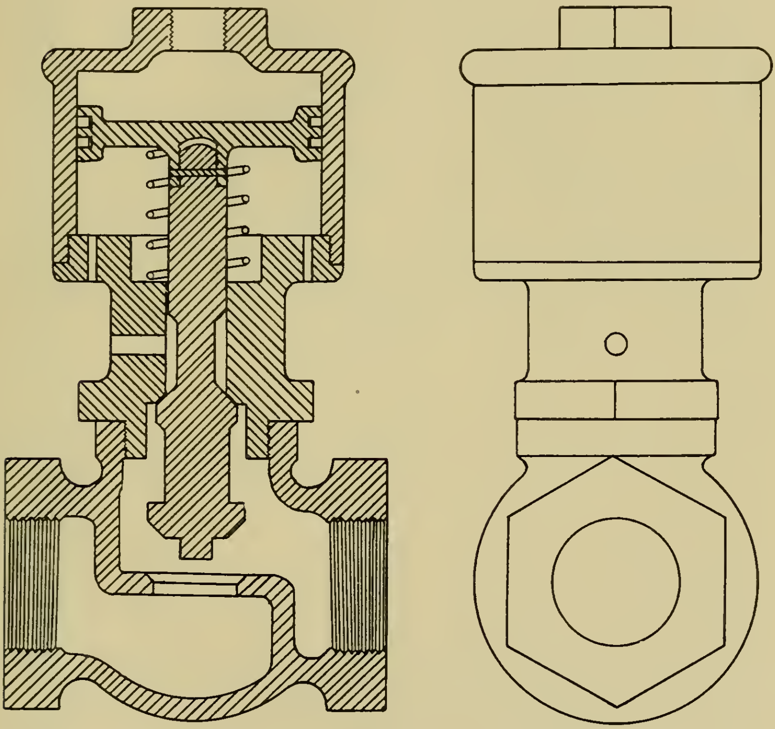


Figure 6 "A"—Automatic Brake Valve

The spring assists in holding the valve seated in its normal position in the upper part of the globe valve, but when pressed forward by the action of the piston, the reservoir pressure is cut off and the pressure of the train line reduced through the ports in the neck of the valve.

Another cross-section view "B" shows how a valve and port controlled by a diaphram enables two kinds of application to be made; namely, the service application controlled by the piston and the emergency application controlled by the diaphram.

One can readily see that the automatic operation of controling and setting the brakes is entirely independent of the engineer's brake valve, which is still under his control.

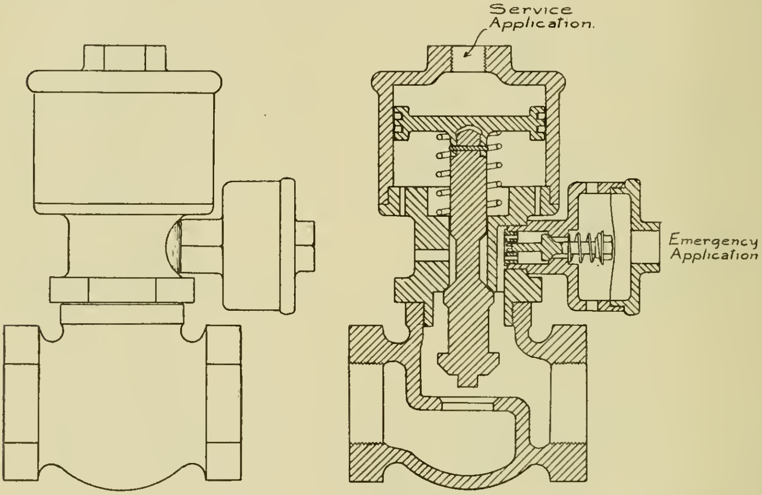


Figure 6 "B"—Brake Valve Showing Emergency Attachment.

Figure 7 shows different views of the recording clock previously mentioned, which is so constructed as to operate a continuous tape over rollers on ball bearings run by the clock, at a speed of three inches per hour, or 1/20 of an inch per minute, which enables one to read to the minute when the tape is lined off in twentieths of an inch, as shown in the cut. The signals are recorded by the relay magnet arm pressing down on a roller cutter, and puncturing the tape as it passes over a grooved steel roller running on ball bearings, located directly under the cutter. Printed on the tape are the four different kinds of signals which the clock records, namely, the caution signal, danger signal, brakes set, and air cut-off.

The first two give the time and kind of signals received, the third whether the brakes were set automatically or by the engineer, and the fourth a record is made when the cut-out valve is closed and the air is cut off for any reason from the automatic control.

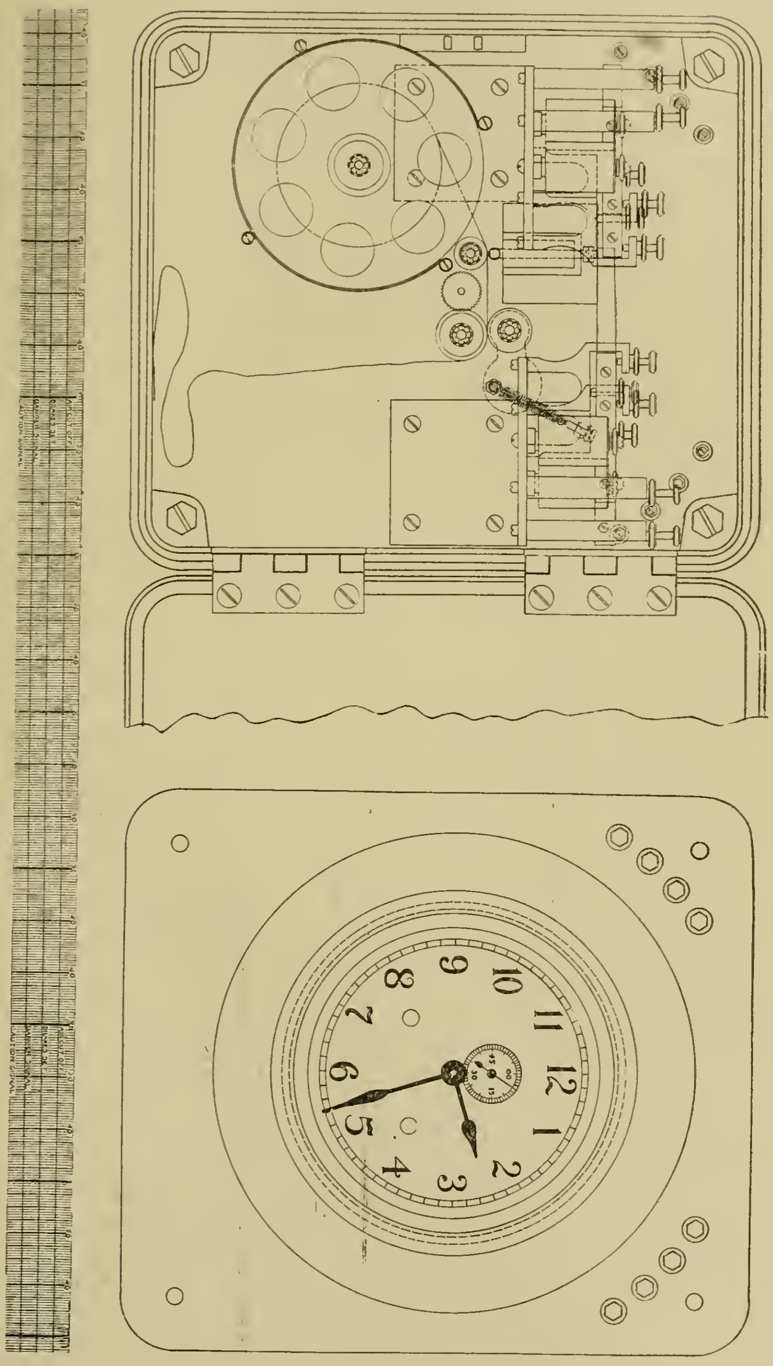


Figure 7—Recording Clock.

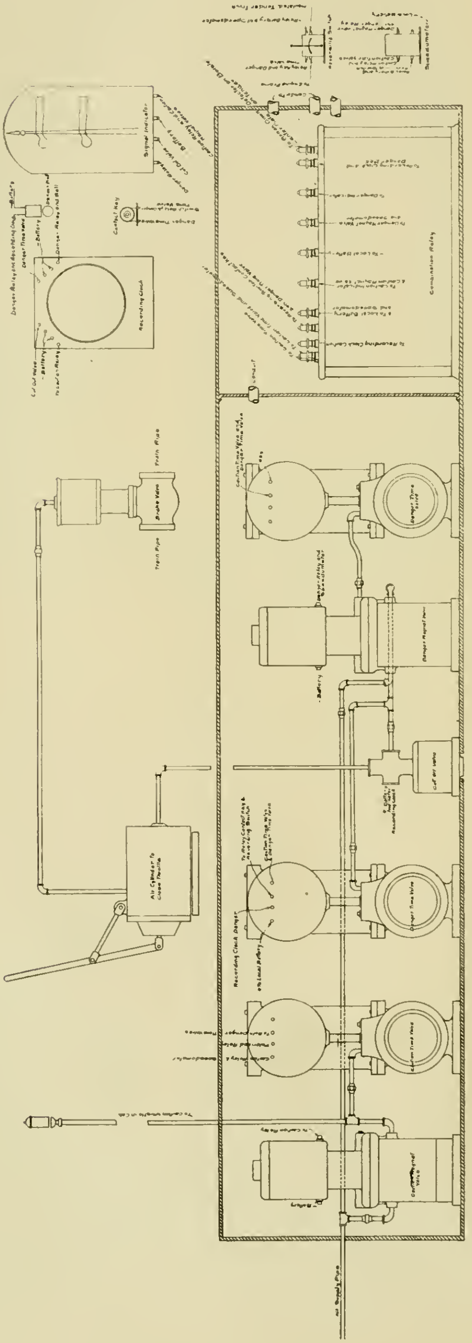


Figure 8—Instrument Box, Showing Apparatus Assembled.

In Figure 8 we have the instrument box enlarged, which was previously shown located on the right side of the engine, directly under the cab. Here it is easier to see the relative location of the different valves and instruments, and also the connections between themselves and the other apparatus located in the cab, as just described. In a compartment by itself is located the cab relay, which is a combination of the standard D. C. relay, and the polarized type, having three sets of magnet coils all assembled in one instrument.

The pipe leading from the high-pressure cylinder runs directly to the two magnet valves, each controlled by the above-mentioned relay, one for the caution signal and the other for the danger signal. Whenever the electrical circuit is opened on one of these magnet valves by the operation of the relay, the air immediately passes through said magnet valve and operates the apparatus under its control. For instance, when the caution signal is given, the relay opens the electrical circuit controlling the caution magnet valve, which in turn releases the air into the pipe leading to the caution time valve and the whistle. Again, if the danger signal is given, the danger magnet valve operates and controls the two danger time valves, as well as the throttle cylinder and brake valves.

Located in the center of the box and connected in the pipe line between the magnet valve and the throttle controlling air cylinder is the cut-out valve previously mentioned, which enables the engineer, in case he so desires, to insert a socket key through the bottom of the box and turn the valve so as to cut the air off from operating the automatic stopping mechanism. This valve would be used in case of double-headers, etc.

Figure 9 shows a view of the combination cab relay just mentioned. This relay controls the electrical circuits on the engine, which in turn automatically operates and governs all the electrical and air apparatus used to give the signals and control the train.

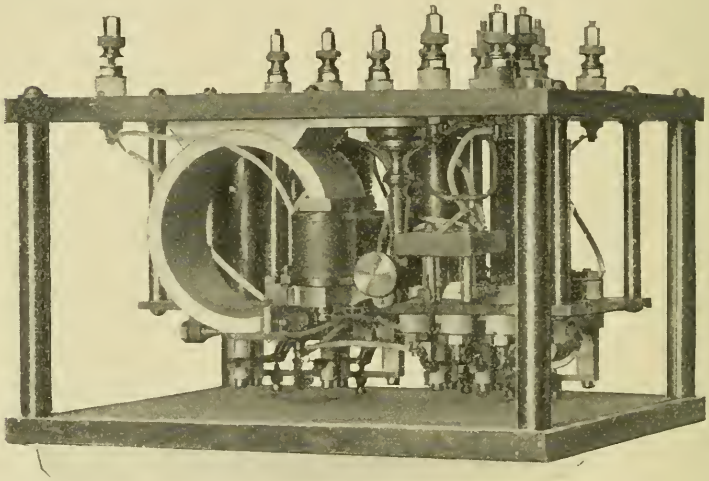


Figure 9—Combination Cab Relay.

In Figure 10 we have a cut of the magnet valve, and also a cross-section giving a good detail view of the operation and control of the air by means of the electro-magnet.

It will be seen that the magnet which controls a small pin valve works in conjunction with a combination of diaphrams and poppet valves, in such a way as to divert the air into the proper ports whenever the magnet is de-energized; and again to immediately close the air valves leading to the high-pressure supply, and open said ports to the atmosphere when the magnet is again energized.

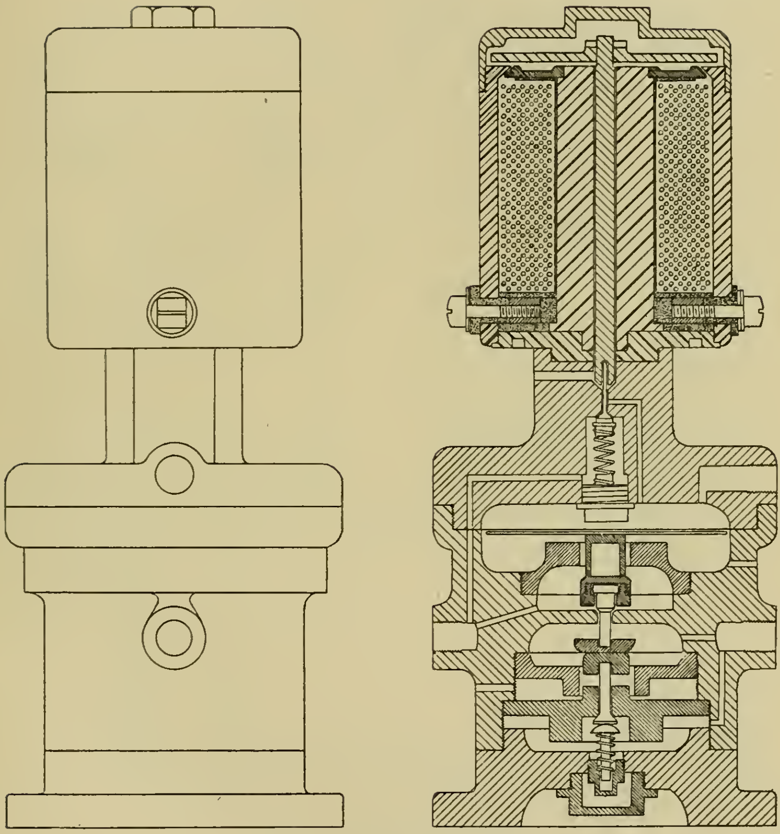


Figure 10—Magnet Valve.

Figure 11 represents the time valve and gives a good view of the Bourdon tube as it is connected to operate as a circuit breaker, and being in cross-section it gives a good idea of the means of controlling the time element required in opening or closing the electrical circuits by the action of the tube.

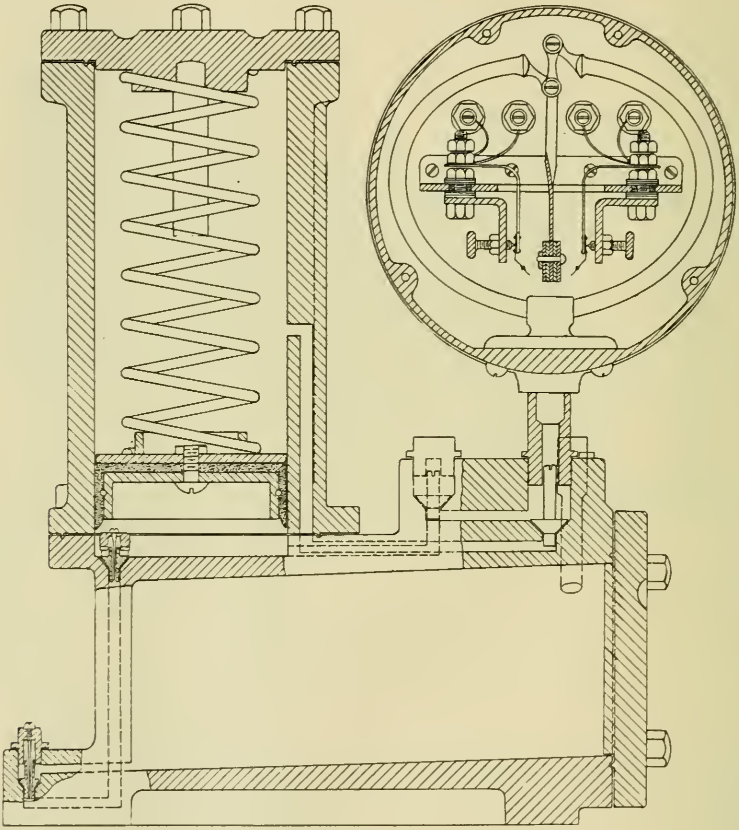


Figure 11—Time Valve.

It will be seen that the time is governed by the period necessary for the air pressure to force the oil or hydrole from one chamber to another through certain valves and ports, which are opened just sufficient to allow for the time required before the tube receives the pressure and operates the electric contacts.

These time valves are used to ensure the absolute stopping of the train whenever the danger signal is given, for the reason that the electric circuits leading to the engineer's contact key are not closed until the Bourdon tube has acted. In this way the engineer cannot again take control of his train until it has time to stop.

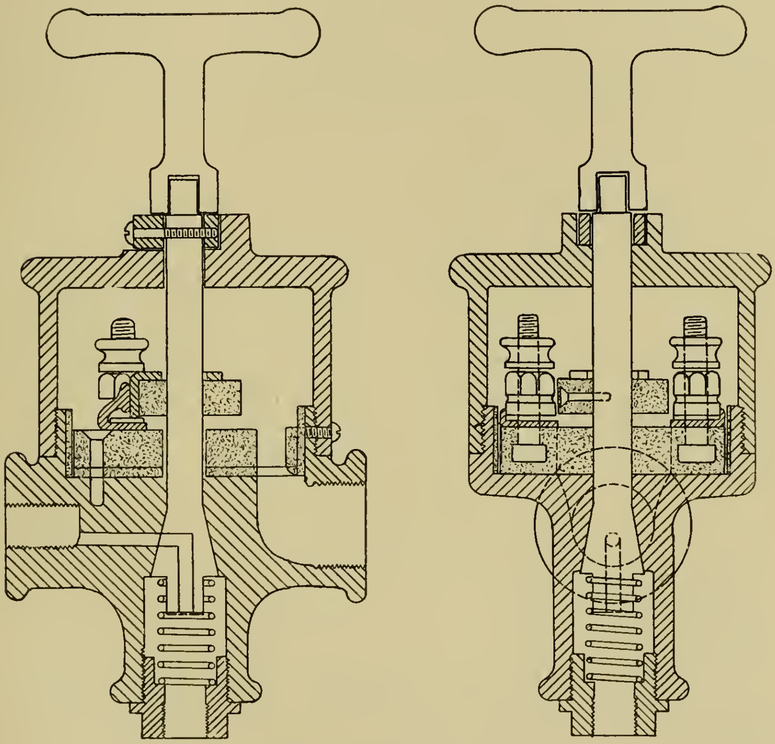


Figure 12—Cut-Out Valve.

Figure 12 is a cross-section of the cut-out valve, and clearly shows how the air is cut off, the records made, and the signal given electrically when the valve is operated.

Having shown the details of the instruments used on the engine, we will now turn our attention to a simplified wiring diagram of the cab circuits.

Most of the instruments shown in Figure 13 we are already familiar with, and I will, therefore, first call attention to the insulation of one of the tender trucks here diagrammatically represented, the details of which will be given later.

This insulation is made of vulcanized fiber inserted between the body bolster and the center plate, or between the truck bolster and the center plate. By the use of this insulation there is no metallic connection between the truck in question and the balance of the engine or train. Therefore, when one of the wires of a local battery is connected to this insulated truck, it necessarily compels the electrical circuit to be completed, through the rails, to the other wheels of the train.

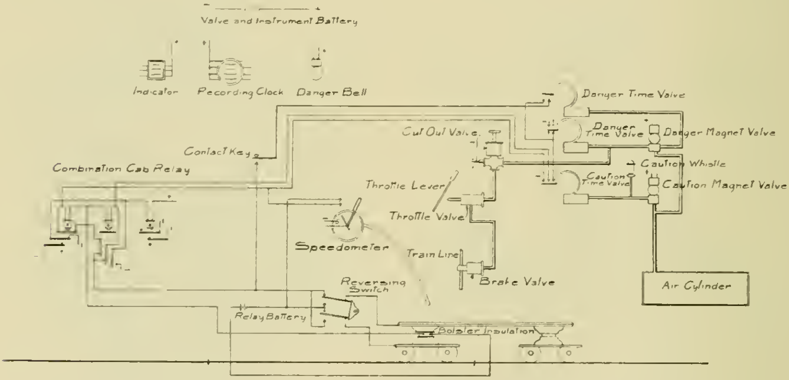


Figure 13—Instruments, Piping and Primary Circuits in Cab.

In this cut all the wires have been eliminated, except those that make up the primary circuit controlling the combination relay, and also the wires from the engineer's key and speedometer, which are the means of re-energizing the relay magnet coils after a signal has been given.

It will be seen that the electrical path of the relay battery passes through the insulated section of the tender truck—in other words, the insulation is divided into two sheets about ⅛" thick, with a thin plate of sheet steel between. This thin steel plate forms part of the path for the battery circuit, and in this way becomes a detector against the breaking down of the insulation on the truck. The reason is easily seen, for should the insulation break down on either side of the plate, it will short-circuit the battery and cut out the relay.

The circuits leading from the engineer's key pass through the contacts of the time valves, which control the time necessary for stopping the train.

The speedometer connections show how the circuits are arranged to avoid the setting of the brakes when the train is traveling below a set speed, say five miles per hour. The reversing switch previously mentioned, on the side of the engine is here shown connected in the battery circuit.

The other instruments and valves with the necessary piping are here shown, but the secondary wiring connections are all eliminated.

It will be seen that a pipe leads from the air reservoir to the two magnet valves, each of which controls its own apparatus. For instance, the caution magnet valve controls the whistle and caution time valve, while the danger magnet valve controls two time valves besides the throttle and brake valves. It is here plainly shown where the cut-out valve, previously mentioned, is connected in the pipe line leading to the throttle.

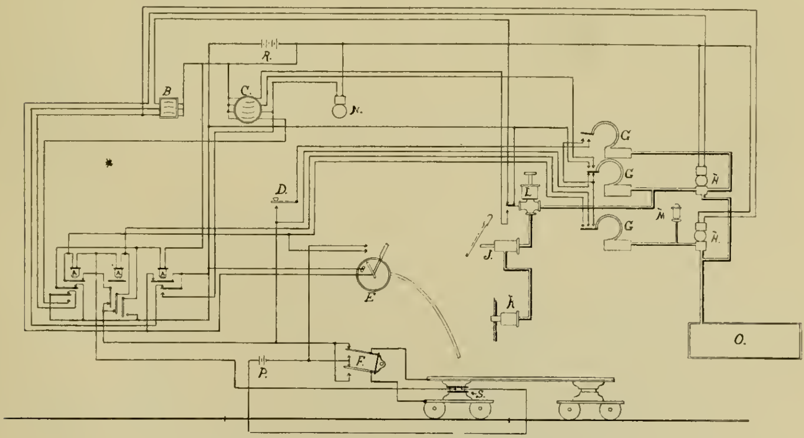


Figure 14—Complete Cab Wiring Diagram.

In Figure 14 we have the complete wiring diagram, showing the secondary circuits, which were omitted in the previous cut.

It will be remembered that the cab relay has one set of polarized magnets which permit two kinds of signals to be received in the cab.

Now, the combination relay controls all the electrical apparatus in the engine, and by tracing out the circuits it will be seen how they operate. For example, one set of coils in the relay controls the caution magnet valve, the caution signal in the indicator and the caution record in the clock, while another set of coils controls the danger magnet valves, the bell, the danger signal in the indicator and the danger record in the clock.

It will also be seen that the cut-out valve is electrically connected with the recording clock and signal indicator. In this way whenever the engineer closes the cut-out valve, in order to avoid the automatic setting of the brakes, a record is made in the recording clock, and the visual indication is given on the face of the indicator by the fan-shaped vane previously mentioned.

Referring to Figures 15 and 16, we have detailed drawings of the form of insulation as applied to the body bolster for the tenders of an Atlantic type locomotive and the type "D" respectively, such as used by the Pennsylvania Railroad. In these drawings the location of the thin metal plate between the fiber insulation sheets is plainly shown. It will be seen that the bolts pass through malleable iron bushings, and the insulated bushings are between the malleable iron and the frame work of the truck. In order to further protect the strain on the bolts, plates of steel are riveted to the bolster at each end of the center-plate, while the edges of the center plate are extended about an inch further over the sides of the bolster, as shown in the cross-section, and in this way it protects the side strain in each direction.

The side bearings are insulated in the same manner as the center plates. A careful study of the plans will show the strength, durability, and safety of this type of insulation.

Having shown the operation of the instruments and equipment in the cab, we will now take up the instruments, wiring, and form of applying same to train control along the track or right of way.

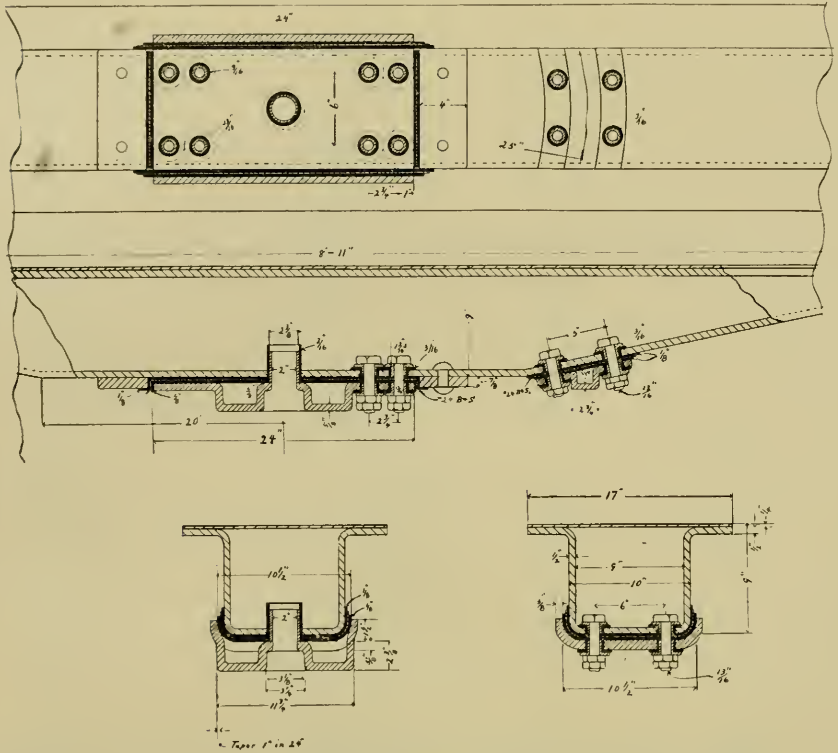


Figure 15—Truck Insulation for Atlantic Type Locomotive Tender.

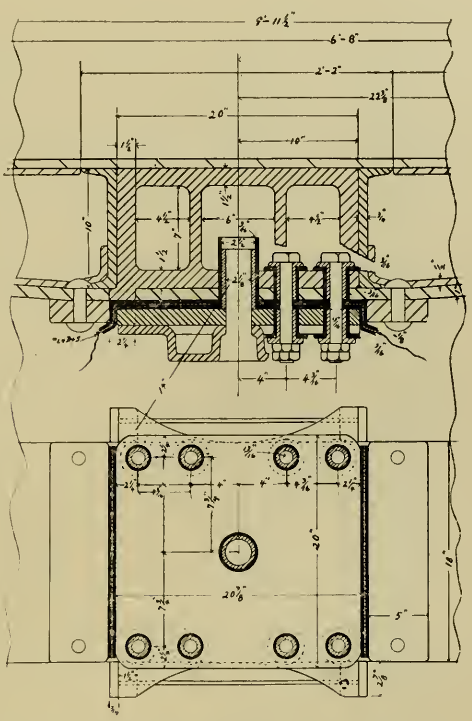


Figure 16—Truck Insulation for Class "O" Locomotive Tender.

Figure 17 shows in a simplified form what takes place on the engine as it approaches the danger and caution signal.

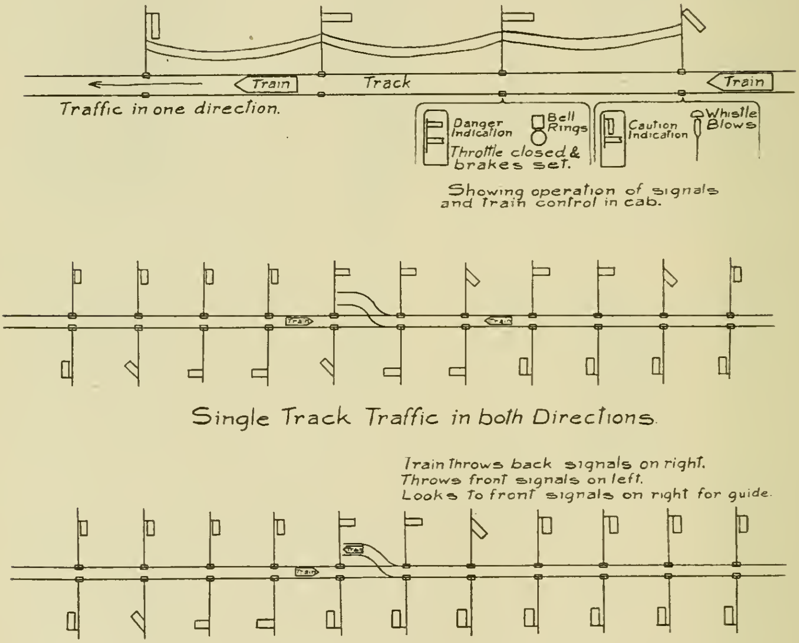

Train
Track
Train
Traffic in one direction.
Danger Indication
Bell Rings
Throttle closed & brakes set.
Caution Indication
Whistle Blows
Showing operation of signals and train control in cab.
Train
Train
Single Track Traffic in both Directions.
Train throws back signals on right.
Throws front signals on left.
Looks to front signals on right for guide.
Train
Train

Figure 17—Application of Train Control to Track.

Right here I wish to call attention to the fact that the system of track wiring is exactly the same as now used by all railroads for their automatic semaphore block signal indications, and that we only use an extra point on the track relay to transmit up through the wheels of the locomotive into the cab the same kind of a signal indication as that displayed by the automatic semaphore signal stationed alongside of the track.

By referring to the diagram for traffic in one direction, we have a track divided into blocks with semaphores shown at the side opposite the insulated joints, and two trains in view. The front one transmitting the signals back over three indication stations, i. e., two red and one caution, and opposite each of the signaling points is designated in brackets what takes place when the engine passes the signaling station—for instance, under the semaphore at a 45 degree angle, or caution indication, the audible and visual signal indications are given, and when the train passes the danger semaphore, as shown by the blade in the horizontal position, the audible and visual danger signals are given, and at the same time the throttle is closed and the brakes set automatically.

We also have represented the indications that would occur on a single track with traffic in both directions.

One of the tracks has the two trains approaching from opposite directions, transmitting their signals as shown by the semaphores; and it will be seen that the train throws the signals to the rear on the right, while the signals in the front are thrown on the left of the track. At the same time, the engineer of the moving train reads the signals on the right for his guide. This is the regular way for handling semaphore block signals on single track, and it will be the exact conditions that take place in the cab of the engine as above described.

Part of the diagram shows where one of the trains has taken the siding, and thus cleared the track for the other train to pass.

With the above simplified form of track signaling and the operation of the signals on the engine, it will now be easy to take up the regular track wiring circuits.

I will first call attention to a simplified form of track wiring with many of the auxiliary circuits eliminated.

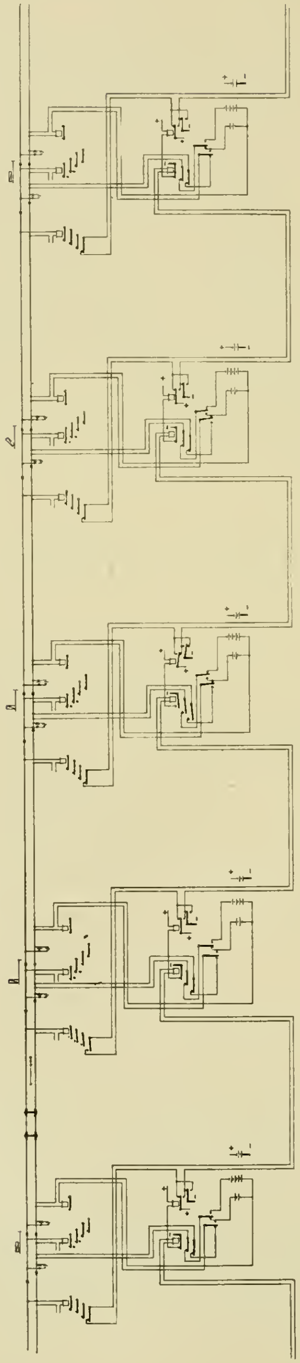


Figure 18—Simplified Line and Track Circuits.

Figure 18 shows the track divided into blocks with the line circuits and one local track circuit complete.

Also the instruments in their proper relative position.

It will be seen from this diagram that the track has four insulated joints at the signaling points which separate from the main block a short insulated section of about one rail length, and that this section is relayed independently.

From our study of the engine circuits it will be seen that an engine passing over these two insulated joints located directly opposite would immediately break the primary cab circuit unless some metallic connection was made around said insulated joints.

In the diagram will be noticed a double wiring connection passing through the points of a compound relay that loops around these insulated joints. This makes a complete metallic circuit around said insulated joints, unless, perchance, some signal has been trasmitted to the compound relay which opens or changes the conditions of this loop circuit.

The compound relay just mentioned is made up of two simple relays which work in combination to control a polarity reversing switch.

This relay is used in the place of the regular line relay, and when the danger signal is given the line circuit is opened, which in turn opens the loop circuit just described, causing a danger signal to be transmitted into the cab, due to the opening of the primary cab circuit when the engine passes over the insulated joints.

It will also be seen that when the danger signal was given the next succeeding station had the polarity of its line relay reversed, which in turn reversed the pole-changing switch and threw into the loop circuit above described a master battery of sufficient power to overcome the local or primary battery of the cab—thus reversing the polarity of the polarized relay in the engine when it passes over the signaling points. This gives the caution signal indications to the engineer in the cab.

Figure 19 shows a view of the combination line relay and the polarity reversing switch just mentioned.

It will be seen that it is all assembled in one instrument, and can easily be connected in the place of the regular line relay.

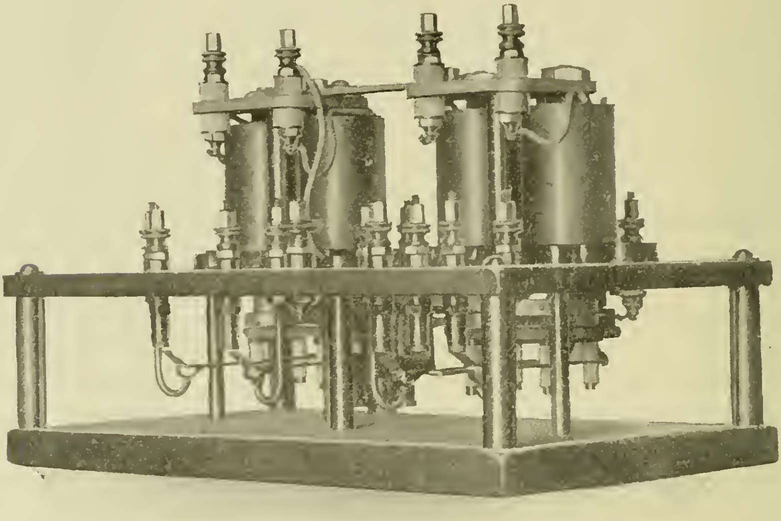


Figure 19—Line Relay.

We are now prepared to take up a complete wiring diagram, as shown in Figure 20, which represents the circuits as they are applied to the Pennsylvania Railroad, and used as an auxiliary train control to their present block signal system.

The extra local circuits shown in the diagram are for the purpose of detecting the breaking down of insulated joints, broken circuits, injury to batteries, or any other abnormal conditions appearing in the system.

Briefly, in summing up the operation of train control as applied to the locomotive by the Gray-Thurber system, the apparatus used is all designed along well known principles of electrical and mechanical engineering, and the application of the system is carried out in exactly the same way, by using the same methods, and the same type of instruments and equipment as used in actual every-day signal practice by railroads equipped with the up-to-date

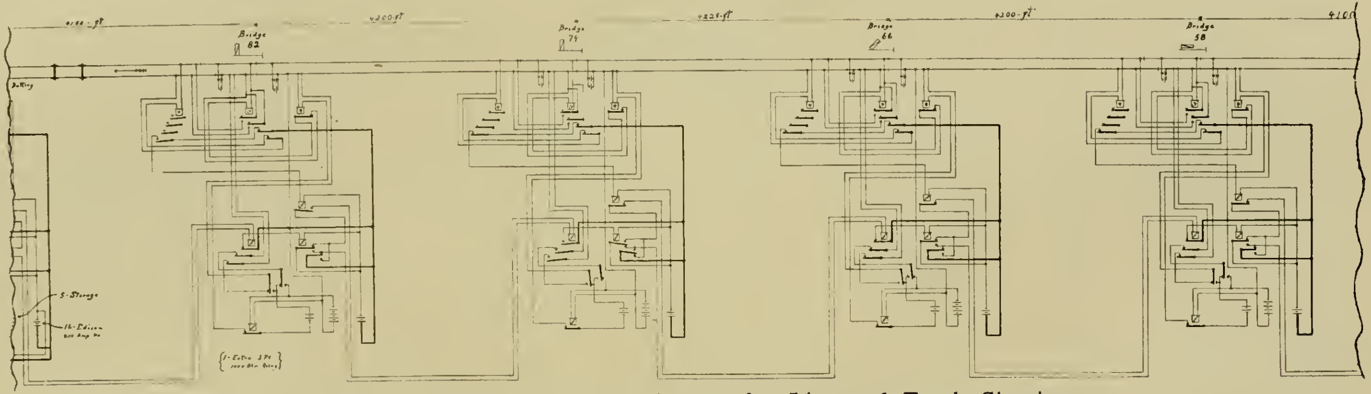


Figure 20—Complete Wiring Diagram for Line and Track Circuits.

standard automatic block signal system; and whatever can be relied upon in the present automatic block signal system for handling and signaling the trains from the outside along the right of way, can just as accurately be relied upon to transmit signals into the cab of the engine, and there control the train automatically, should there occur a possible failure on the part of the engineer to perform his duties, and thus endanger life and property.

We will now take up the application of train control to electric or interurban railways, as shown in Figure 21.

On account of the track being used for the return circuit of the propulsion current on most of the electric traction company lines, it is impossible to use direct current for signaling purposes. We, therefore, have worked out an alternating current system which will apply to electrified railroad and steam railroads just as readily as the D. C. system previously described.

In case the propulsion current should be alternating current, we would then use another phase of alternating current and adjust our instruments to work on that particular cycle; for example, if the propulsion current used on the cars or trains should be 25 cycle, we would use 50 or 60 cylcle for the signals, etc.

Now, it is a well known fact that an alternating current will not flow readily through a coil, but will be choked back by its own counter electro-motive force, and we, therefore, use this well-know principle at the insulated joints, where we wish to separate the blocks by installing what is known as induction bonds of sufficient carrying capacity to transmit the entire D. C. propulsion current traversing along the rails, and at the same time chokes back the signal alternating current from going over the induction bonds into the adjoining block.

This signal current is supplied from alternating current transformers, while the relays and other instruments are built to operate on the same kind of current.

By referring to the diagram of the cab circuits and instruments, it will be seen that the general plan is the same as that carried out on the locomotive. The general principle of transmitting the signal to the car is by insulating one of the trucks as heretofore. Instead of batteries to supply the current, we use a small motor-generator or dynamotor, and a circuit-breaker is used to

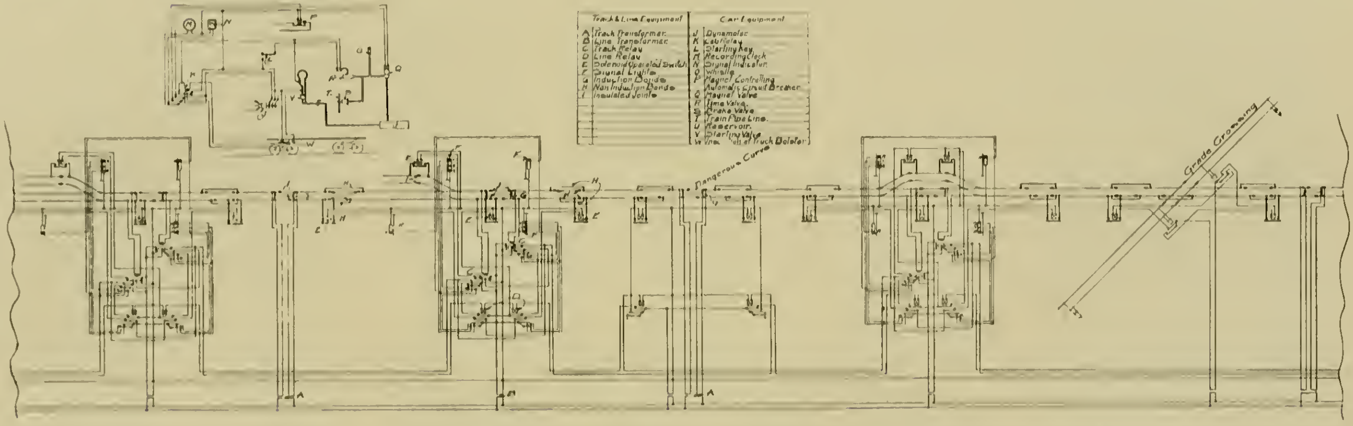


Figure 21—Wiring Diagram for Electric Ttraction and Interurban Railways.

cut off the power in place of operating a throttle closing device. All other instruments are practically the same, except that they are designed to work on A. C. current. The operation of the train control on the electric train or car is exactly the same as just described for the locomotive.

It will be observed that the track-wiring diagram is worked out for a single track with traffic in both directions, such as most frequently used by our interurban lines. The signals and applications of train control are located at or near the sidings or passing points.

At a full braking distance each way from the siding, is an insulated section of track, made so by the use of the insulated joints. These short sections are of sufficient length to admit one truck of the car only to rest upon it at the same time, and bonded around them is a non-inductive copper cable of sufficient carrying capacity to transmit the entire propulsion current of the rails. The short insulated rail section is connected to the main track through a solenoid controlled circuit-breaker of sufficient carrying capacity to supply the propulsion current for one car. This solenoid is controlled by the track and line relays, and when opened it breaks absolutely all possible electrical connection between the insulated section and the main track. This, of course, gives the opportunity for our train control, and when located at a sufficient distance from the point of danger to guarantee absolute protection, we have eliminated the danger element which now stares the traction companies in the face. All the instruments are at or near the switches, while the signal current is supplied to the rails at approximately 10 volts pressure, from a transformer located about half-way between sidings.

The line instruments are fed from a 110-volt transformer, and that enables us to use the same current for the signal lights, which are wired to show the location of a train between blocks to any other train approaching a siding, and at the same time it insures absolute protection by train control to all cars or trains whether traveling between switches or standing at the sidings.

In conclusion I wish to say that it has been impossible for me to do justice to the subject in the short time at my disposal.

I have only been able to touch on some of the important points without going fully into details, and have tried to show in brief the application of the Gray-Thurber system to train control for both steam and electric traction or interurban railways.

In order to clear up any matters not fully understood on the subject, Mr. Gray or I will be more than pleased to answer all the questions you desire to ask to the best of our ability.

DISCUSSION.

MR. A. G. MITCHELL: Is this system in use now?

MR. THURBER: No, sir; it is being installed at the present time on the Fort Wayne Railroad.

MR. MITCHELL: Then you cannot give any idea of its cost?

MR. THURBER: We use the same system of track wiring and track circuits that is used at the present time, and for that reason I would say it would cost a little more because we have to equip the engine also. If the semaphores are used, which is the rule of the Signal Association, the extra cost should be only the cost of the train control, which is on the engine.

A VOICE: What is the object of the dead section at the signal in the block?

MR. THURBER: Do you mean on the inter-urban or the steam lines?

A VOICE: The steam line.

MR. THURBER: If I said dead section I made a misstatement. I meant insulated section of the track. It is insulated from the main track when a signal has been transmitted from a succeeding station to open the relay in the loop, which opens the loop circuit controlling that section, and that gives us the signal. It breaks the primary circuit in the cab and gives the signal that is required.

A VOICE: We do not use a dead section in the automatics.

MR. THURBER: If I said dead section I was misunderstood. It is an insulated section of track, and it is made so at that particular instant when a signal has been transferred back.

MR. G. B. GRAY: May I' help you out a little as to that? There is no dead section in the track on a steam railroad. There is a short rail section at the end of the long automatic track section that is exactly like the usual automatic track section, only it is short, a length of rail, relayed, giving the regular automatic operation, so there is not an inch of dead section.

MR. THURBER: I want to say that Mr. Gray, Signal Engineer, of the Pennsylvania Railroad, is my co-partner in this work. He is the practical signal and operating man, while I am an electrical and mechanical engineer, and I do not pretend to be an expert signal engineer, consequently I am liable to make mistakes in my statements, and I want him to correct me.

MR. B. D. LOCKWOOD: What is the reason for the insulation of one truck as against the other one, and how do you expect to maintain that insulating fiber with 90,000 or 100,000 lbs. pressure on them, without any breaking down and getting open circuits and consequent signals?

MR. GRAY: The surface covered by the fiber is about 16″ square, if I remember right, which will stand a considerable amount of pressure, and if there is no lateral motion there will be but little wear on the fiber.

MR. LOCKWOOD: There is lateral motion.

MR. GRAY: Yes, but we are providing to take care of it.

MR. LOCKWOOD: It is a serious matter. We have hundreds of thousands of cars in the country which are moving all the time and we have a hundred square inches of bearing to take 90,000 lbs., and that is not the top notch by any means, and then you have in that diagram a boss in the center which takes the center pin, which is supposed to have a machined hole in order to help out and it don't.

MR. GRAY: No. The center pin, as you will remember, is a very loose member and all the insulation necessary around the center pin will be the fiber bushing and next to the center pin an iron bushing, malleable perhaps, to take the wear off from the fiber in case the center pin should be thrown against the fiber when receiving the shock of the vibration.

MR. LOCKWOOD: That is only secondary to what I mean. Why is it necessary to insulate that truck and not the other one?

MR. GRAY: The indications are taken up through the wheels of the engine or train. If there were no insulation between two pairs of wheels and they were metallically connected, then the circuit would remain constantly closed. In order to make it possible to break that circuit when passing over an insulation it becomes necessary to insulate one pair of truck wheels from the other, and to do that we have selected a pair of the tender truck wheels to be insulated from the body of the tender, that is from the car bolster.

MR. LOCKWOOD: It becomes necessary for that truck to pass over the insulated joint before it becomes operative?

MR. GRAY: That would depend on which way you were running. If you were backing up you would have to pass over it first. If you were running ahead the engine would pass over it first. The signal would be given at the time the insulated trucks are on one side of the insulated joints and the drivers of the engine on the other side. If there were no insulated trucks then there would be metallic connection completed around the insulated joint and there would be no signal given, it would pass over with an unbroken circuit. But if the train should be in advance then the track circuit occupied by the train through its track relay would open the line sending a signal back one or two blocks as the case may be. This in turn would open the metallic connection around the insulated joints and when the train passed over it the circuit would be broken at the time the insulated truck is on one side and the drivers of the engine on the opposite side of the insulation.

MR. LOCKWOOD: It is all battery operated circuits?

MR. GRAY: Yes.

MR. LOCKWOOD: That clears it up so far as I am concerned.

A VOICE: What effect would the excessive use of sand have on that system?

MR. GRAY: There is a possibility, if the sand is heavy enough to completely insulate the rail from the drivers or wheels of the train, that you would get a danger signal, just the same as I have known in some cases with the automatic signals that are used to-day. I remember one time of there being considerable trouble in a tunnel due to the fact that there was trouble with some substance accumulating on the rail. Another place where the sanding was very heavy a train would pass the automatic signal 300′ from the mouth of the tunnel, would pass the signal at clear and would be out of sight in the tunnel before the signal would go to danger. The track was completely insulated with sand or something of that kind. If a place was sanded so that the circuit was completely broken between the wheels of the tender and the wheels of the engine, there would be a danger signal given in the engine. It could not carry a clear signal.

A VOICE: Do I understand that the danger signal would be on the train sanding the rail excessively, or on the following train?

MR. GRAY: On the train that sanded the rail.

A VOICE: How about the train following?

MR. GRAY: The train following would be held up or controlled by the contact of the other wheels of the train. Any pair of trucks on any train crossing the track will shunt the track battery from its relay and produce a signal in the rear. If it were sanded so that the entire train was standing on sand, then that train would give no signal to the train that was following it.

MR. A. STUCKI: I understand this is set for danger all the time. Supposing the wire from the signal ahead gets interrupted so you do not get any current back to the relay, would that not mean that the relay is inoperative on the train?

MR. GRAY: No, the relay is normally energized. All parts of the system are in what is termed a normally closed circuit, so that the interrupting of any of its circuits would result in a signal indication.

PRESIDENT: Mr. C. O. Herrington, of the Union Switch & Signal Co., is here, and we would like to hear from him.

MR. C. O. HERRINGTON: I have some questions to ask Mr. Gray. These lantern slides came so rapidly one could scarcely follow the details. One point I did not quite understand was the bringing of two wires to one rail and what was called a dead or insulated section. I could not follow the circuiting. Also the purpose of that master battery.

MR. GRAY: One of those wires is a connection from a relay near the right hand side of the diagram to the track. The object of this relay is to detect the breaking down of track insulation. In case the track insulation breaks down, the relay would be short circuited. Short circuiting the relay would open the operating circuit around the track insulation resulting in a danger indication on the engine, because of that part of the system being out of order. The other wire that you saw is the path around the insulation which is closed by the relay.

MR. HERRINGTON: You refer to those two wires connected to one rail?

MR. GRAY: Yes. One of them leads from the short section of rail down to the relay contact and back to the rail, forming a loop around the insulation if the relay is closed. The other one has a relay in it connected up so that it holds that relay closed constantly. In case of the breaking down of an insulation the arrangement of the circuit is such that the relay battery will be short circuited, passing through this loop that goes around the insulation and producing a short circuit on the battery and the detector relay is de-energized and falls open. This will open the line circuit producing a signal back one or two blocks according to the system that is used.

MR. HERRINGTON: Is that to take care of a break down on an insulated joint or anything of that kind?

MR. GRAY: That is just what it is. So long as the insulated joint is of sufficient strength to permit current to be carried, or to interrupt the carrying of the current in the engine circuit when the engine is passing over it, that relay would be closed. When the insulation breaks down sufficient to allow current to pass through it, then that relay would be de-energized and open the line. It is a detector against broken down insulation. All the insulated joints are protected through the same general arrangement.

MR. HERRINGTON: Is that master battery intended to reverse the polarity?

MR. GRAY: Yes. The polarity of the operating battery on the engine. If the loop around the insulation should be open through its relay then, naturally, you would get a full application on your engine, that is, you would get a setting of the brakes and the steam would be shut off every time you passed over an insulation where the loop was broken. Then you want to differentiate between a caution signal and a danger signal. If you do not, it is of no value. You would have something that is not a protection but an invitation to disaster. Because if the caution signal fails (and there is nothing that man ever made that is not going to fail sometime, particularly if it is a signal), your cautionary indication is the same as your danger indication and you have a failure of the caution signal, you get the danger signal, but your engineer reads it caution. You see what happens. Just where you are when your automatic signal sticks at caution. The object of that master battery, which is connected to the track, when the polarity of a line circuit is changed is this, the battery has one terminal connected to the track on one side of the insulation, and the other on the adjacent side in the opposite polarity to the battery on the engine. The battery on the engine is about the strength of an ordinary track battery. The master battery is of sufficient strength to overcome or change the polarity of that light engine battery. It results in the shifting of the polarized contacts in the engine relay, connecting them through the polarized contacts of the cab circuit which controls the danger indication, namely the one that applies the air and shuts off the steam. It is then held closed. The indication that now comes in is through a time valve that was explained, namely, the blowing of the whistle, the setting of the caution indicator and the registering of the caution signal on the tape in the time recorder. That is the object of the master battery. It is of sufficient strength to reverse the direction of the flow of the current through the engine equipment, that opens a portion of the engine relay through the polarized relay and avoids the application of the danger signal.

MR. HERRINGTON: The question has been asked regarding putting the insulated truck on the tender of the locomotive. I rather judge that the question that was asked before was intended to bring out this, that in case you left your tender off or had any occasion to have your tender disconnected, the engineer would be practically helpless and would get no indication at all. I suppose that is very unlikely?

MR. GRAY: He would very likely get his brake set and his steam shut off.

A VOICE: In the event of a service application, do the brakes apply to a full service or a partial service?

MR. GRAY: That can be as the operating officials desire. It has been suggested by some signal engineers that there be two kinds of air application; that is, at a caution signal there should be a light application, not perhaps a full service application, but sufficient to slow the train under that caution signal. I do not know whether I agree with them or not. But it can be service application or emergency application, just as they may choose one or both.

A VOICE: In the event of a partial service application, what would prevent the main reservoir air from releasing the brake, or, in other words, how long would the train line exhaust continue to blow at the reduction made by the control system?

MR. GRAY: It would be a very short period of time. The intention of the caution service application would be to exhaust to the open air for a short period of time, sufficient to make an application of the brake that would steady or slow the train. The system is susceptible of making that application and that operation entirely automatic. It may be adjusted to exhaust whatever quantity of air may be desired.

A VOICE: Do I understand that the main reservoir on the train line is cut off when this valve makes the application?

MR. GRAY: It would be a service application, yes. That does not bleed the main reservoir.

A VOICE: I understand that it would not bleed the main reservoir. Does the main reservoir air continue to flow into the train line when the automatic valve is taking the train line air away?

MR. GRAY: No.

A VOICE: It does shut off the main reservoir air way?

MR. GRAY: Yes; the operation is precisely what it would be with the engineer's valve.

MR. JEWETT COLE: Wouldn't you be bleeding air into your brake pipe at the same time this reduction was made?

MR. GRAY: No.

MR. COLE: Why not?

MR. GRAY: The function of the brake valve in applying the brakes is the reducing of the pressure. That is just exactly what your brake valve does. In emergency you have not very much air left in the train line.

MR. COLE: I do not understand yet how you get that reduction. How do you cut your feed valve away from the brake line?

MR. GRAY: The construction of the valve is such that in making your service application the port to the open air is open only for a limited time that would be sufficient for service application. The air is shut off almost immediately from the main reservoir.

MR. COLE: Between the main reservoir and the brake pipe?

MR. GRAY: Yes.

MR. COLE: Do you have a valve to do that?

MR. GRAY: Yes.

A VOICE: How are these control sections of track located in relation to the signal bridges? Are they set between in the middle of a block?

MR. GRAY: No, right at the signal.

A VOICE: Then what is to prevent a train from running past a danger signal?

MR. GRAY: I do not quite get your idea.

A VOICE: If an engine comes up to a caution signal and this automatic control makes a service application that may be sufficient to bring the train to a stop before it comes to the next signal, which would be set at danger, or it may not be sufficient. If it is not sufficient then the next controlling section of track is located directly under this signal bridge, and it does not become operative in the engine until a locomotive has passed on to it and over it and past the danger signal.

MR. GRAY: That would depend on where you locate the track insulation. If the track insulation is opened within the track before reaching the danger signal of course the brake application would be made before you passed the signal. If it were made just opposite the signal the application would be made when the engine was passing the signal.

A VOICE: Where the signal is opposite the gangway in the engine?

MR. GRAY: The short section being the same as the automatic track circuit section in any signal system is wired back into the relay. In other words, the automatic signal control is carried through the two relays so that is simply an extension of the relay section. The operation is similar to what it would be if you had a split section, two miles of section and it is too long for one track circuit and you divide it in the middle. It is practically the same system.

MR. WM. ELMER: Do I understand that this would have prevented that accident on the New York Division at Menlo Park a few years ago where the train stopped just east of the home signal?

MR. GRAY: It would.

A VOICE: As I understand the track signal connected with this apparatus is what we know as the double block system; if there is a train in the block there are always two red signals and one caution signal in the rear of that train. When you pass the first caution signal you get the service application, and when you pass the first red you get the emergency, and then you still have one more block to run through before you get into the real danger zone.

MR. GRAY: Yes, sir. The train might be just two inches over the insulation on the next block, and if you do not make the application there, you would go a block before it would stop.

A VOICE: I suppose you could make a heavy enough application at the signal to stop you from reaching home?

MR. GRAY: Yes, it could be done. But we do not consider it desirable to do it because then your signals are too near the same. Your caution and danger signals are practically the same.

A VOICE: Then, in answer to Mr. Elmer's question regarding the accident at Menlo Park, that accident ought to have been avoided by this contrivance because there they got a caution signal and the next was the home signal and they were in the danger zone.

MR. GRAY: Yes.

A VOICE: It ought to have avoided the accident. They got a caution signal and failed to stop before they passed the first red home signal and the collision occurred.

MR. GRAY: Where it is operated just on a red and a green, that is a danger and caution signal, there is that possibility. We would not try to operate our system of signals that way. We have the three indications. It is necessary to do so in order to get braking distance after the danger signal is given. Had this been in use that is the way it would have been installed.

A VOICE: Are you acquainted with our system of double blocking on the main line of the Pittsburg Division between East Liberty and Pittsburgh?

MR. GRAY: I know something of it, yes. I am not as familiar with the system as some of you.

A VOICE: There are always two red signals in the rear of the train. And that is what you would have to have in this?

MR. GRAY: Yes.

A VOICE: That system of yours could be applied to a double green scheme?

MR. GRAY: Yes, just as well.

A VOICE: Then you would not run under a red home.

MR. GRAY: In that case, if you had two greens, you would have to make the danger application at the second green signal or you would not have sufficient braking distance. And the indications in that case could not be precisely what they are with the automatic signal.

A VOICE: Do I understand this brake will not apply until the throttle is shut off?

MR. GRAY: The throttle is shut off first, and then the brake application is made.

A VOICE: In case that cylinder did not work in the throttle you would not get any brake application.

MR. GRAY: No.

A VOICE: What is the size of the cylinder?

MR. THURBER: 3 1-2 inches in diameter.

A VOICE: What is the pressure?

MR. THURBER: 110 lbs. to the square inch.

A VOICE: What is the average?

MR. THURBER: About three to one.

A VOICE: Speaking of a cut-out cock, if the engineer so chooses he can cut out the whole system?

MR. GRAY: The object of that is this: A good many years ago the Supreme Being created a lot of things; among others he created man, the most perfect of His handiwork, and he fails. If God failed to make something that would not fail, you can hardly blame mankind for having failures occasionally in his appliances. In case there is a breakdown in the system that is irreparable you are tied up out on the road. The brakes will be set and steam shut off and there will be no chance of releasing if your electric appliance is out of commission. Or some function of the brake apparatus might go wrong. You have got to get over the road, or you want to at least. In case of these failures it is left in the power of the engineer to cut off his air from the brake valve and from his throttle closing cylinder. The only safeguard that you have against it, is the record that comes in against the engineer on the time recording strip of the clock giving the time that he closes it and the length of time it is off.

MR. THURBER: Mr. W. A. D. Short, of Cincinnati, is in the room. He is one of the best known signal engineers in this country and known to every signal engineer here. He is at the present time a free lance, not being connected with any of the signal companies or any railroad company, though he has been chief signal engineer for several years of some of the largest railroad systems in the United States. I am sure you would like very much to hear from Mr. Short.

MR. W. A. D. SHORT: I thank you very much, gentlemen. I came here to-night to learn something. I do not know that there is really anything that I can say. I am familiar with this system. I have looked into it for my own satisfaction as well as others, and the only thing I can say is that I think we are coming on the railroads to train control. It has only been about the last year or two that the railroads knew what they wanted any more than signal engineers knew a year or a year and a half ago what they wanted in automatic train control. They have to get out the specifications, and they haven't got them completed yet.

I think the automatic train control is going through about the same thing that the automatic block signal went through twenty years ago. We have all got to be convinced that it will work, just like your automatic block signal. It seems to me we are coming to it very rapidly, especially as we have had two very disastrous wrecks on two of our biggest railroad systems in this country that were perfectly protected by automatic block signals. Within the last three months two of our fastest limited trains were wrecked and automatic train control would have stopped it. I have had several operating officials of the big roads in the Middle and Farther West tell me within the last year that they all believe we are coming to automatic train control. A general manager of a railroad told me he thought they would come to it, and he hasn't got a mile of automatic blocks on his system. Still he is coming to automatic train control. Thank you very much.

PRESIDENT: Are there any others who have any questions to ask?

A VOICE: I would like to ask what would be the effect of a washout or a landslide or a slide of the track, on this system?

MR. GRAY: If the track should be broken there would be a danger signal.

A VOICE: If a washout occurred or it were obstructed by a landslide?

MR. GRAY: It would result in the same thing that would occur if there were a train standing where the washout was, a danger signal first and a caution after that would be conveyed back three blocks from the point of the washout. In other words, the first indication you would get would be the caution indication, the next would be the danger indication, with a full block to stop before coming to the washout.

A VOICE: And in case of slides or high water after heavy rain?

MR. GRAY: It would be affected just as much and no more than what our present automatic signals would.

The effect on the track circuit would be precisely what it is on our automatic signals. If the sliding of the track were of such nature that it would break the track circuit and open the track relays, danger signals would be given just the same as it is with the automatics.

PRESIDENT: Are there any other questions?

MR. MITCHELL: As the discussion seems to be over, I would move that this Club extend to the speakers of the evening our thanks for their very able and interesting lecture which they have given us on this very important subject.

The motion was duly seconded and carried by unanimous vote.

ON MOTION, adjourned.

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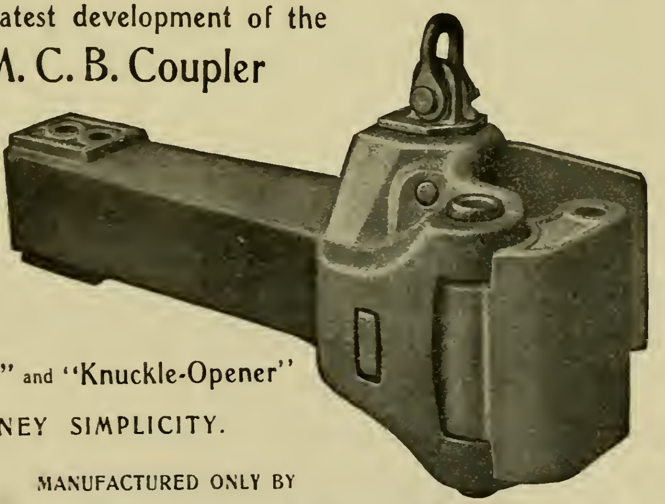

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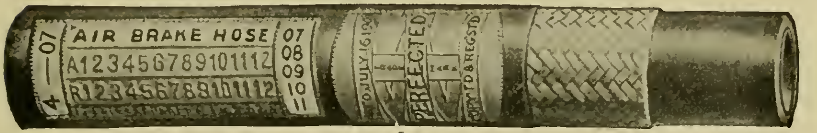

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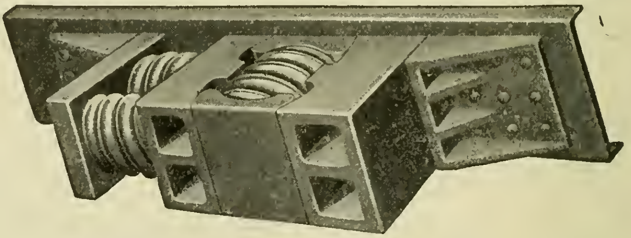

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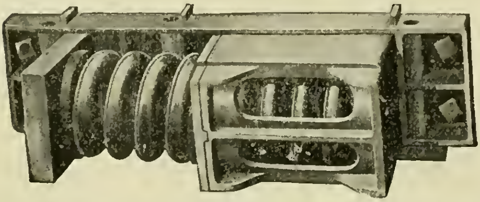

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TESTS OF SPELLERIZED STEEL BOILER TUBES

(No. 8)*

¶ In this space, seven announcements have appeared regarding tests given to SPELLERIZED STEEL BOILER TUBES, and we summarize contents as follows:

(1) This announcement covered some general information about methods of manufacture and qualities of SPELLERIZED STEEL BOILER TUBES.

(2) This announcement covered the CROP END TEST (a crushing test); HYDRAULIC TEST; and INSPECTION TESTS. Two illustrations were shown.

(3) This announcement covered the FLANGE TEST. There was an illustration showing five samples of tubing, approximately 1 inch long and 2 inches in diameter, which had been flanged to a diameter of approximately 3 inches. One piece of tubing had also been flanged back against the center—an exceptional test, proving the excellent quality of the material.

(4) This announcement covered the PIN TEST. In this test a tapered pin is forced into a piece of SPELLERIZED STEEL BOILER TUBE—both pin and tube being cold—the tube is opened up to a diameter one-sixth greater than original diameter. There were two illustrations.

(5) This announcement covered the CRUSHING TEST. In this test samples of SPELLERIZED STEEL BOILER TUBE about 2½ inches long were crushed by repeated blows from a steam hammer; the results were exhibited on six samples in the illustrations.

(6) This announcement covered the TUBE SETTING TEST. A piece of SPELLERIZED STEEL BOILER TUBE is inserted in a section of tube sheet, and the tube forced into a plate with a Prosser Expander, then flanged and beaded over. The accompanying illustration demonstrated the process fully.

(7) This announcement covered the ROLLING and BEADING TEST. A piece of SPELLERIZED STEEL BOILER TUBE has been rolled and beaded until it has been almost rolled away without a fault or fracture in the tube. Two illustrations were shown.

¶ The series of announcements above outlined were intended to indicate something of the great care taken in the manufacture and testing of SPELLERIZED STEEL BOILER TUBES.

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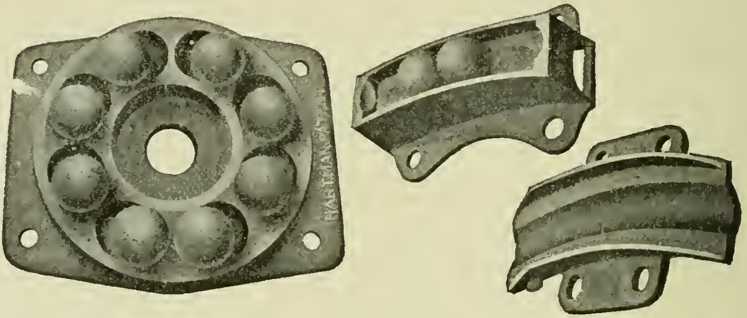

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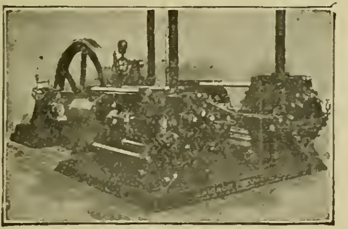

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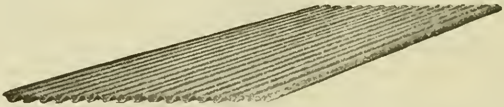

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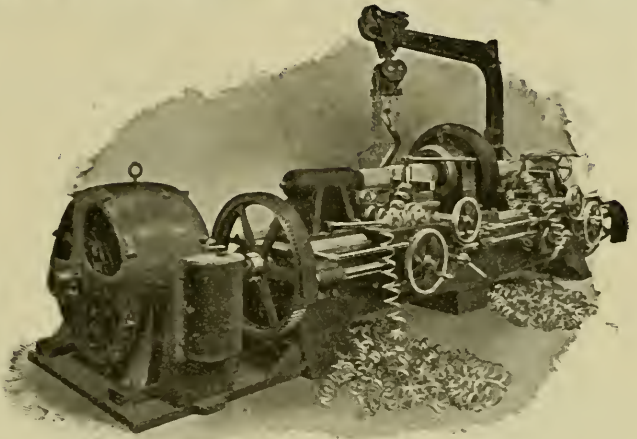

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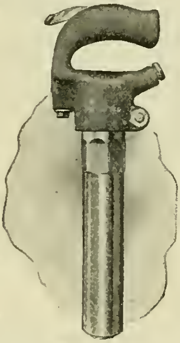

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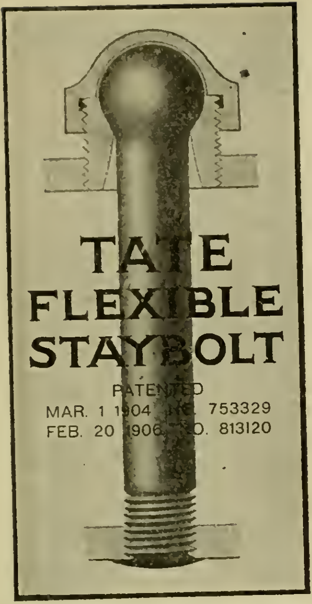

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INDEX—ADVERTISERS.

NAME — Page

American Brake Shoe & Foundry Co. iii
American Locomotive Company. . viii
Ashton Valve Co. xi
Ball Chemical Co. ii
Brady Brass Co. . . . . Front Cover
Butler Drawbar Attachment Co. . . xviii
Chicago Pneumatic Tool Co. v
Clancy, J. R. xvii
Cleveland City Forge & Iron Company. . . . . Front Cover
Crosby Steam Gage & Valve Co. . . v
Damascus Brake Beam Co. xvii
Dixon, Jos., Crucible Co. vi
Flannery Bolt Co. xi
Fort Pitt Malleable Iron Co. xii
Franklin Manufacturing Co. viii
Galena-Signal Oil Co. xii
Gold Car Heating & Lighting Co. . vi
Gould Coupler Co. ii
Gray-Thurber Automatic Train Control and Signal Co. of America x
Homestead Valve Mfg. Co. iv
Hunt-Spiller Mfg. Co. xi
Ingersoll-Rand Co. x
Lawrenceville Bronze Co. xv
Lino Paint Co. . . . . Back Cover
Long, Chas. R. Jr. Co. iii
Magnus Metal Company. vi
Manning, Maxwell & Moore. iii

NAME — Page

McConway & Torley Company. . . . xv
Nathan Manufacturing Co. iv
National Car Wheel Co. iii
National Malleable Castings Co. . . vi
National Tube Co. i
Niles-Bement Pond Co. ix
Page Woven Wire Fence Co. . . . . Front Cover
Peerless Rubber Mfg. Co. xvii
Pittsburgh Coal Co iv
Pittsburgh Equipment Co. . Back Cover
Pittsburgh Testing Laboratory. . . . . Front Cover
Pressed Steel Car Co. xx
Railway Steel Spring Co. xvi
Safety Car Heating & Lighting Co. xvi
Sipe, James B. & Co. . . . . . Front Cover
Standard Coupler Co. xix
Standard Steel Car Co. xviii
Steel Car Forge Co. . . . . . . Front Cover
Suydam, M. B. Co. . . . . Back Cover
Union Spring & Mfg. Co. xiv
Union Steel Casting Co. xix
Ward Equipment Co. xix
Washington Coal & Coke Co. ix
Western Railway Equip. Co. Front Cover
Westinghouse Air Brake Co. vii
Westinghouse Electric & Mfg. Co. vii
Westinghouse Machine Co. vii
Wood, Guilford S. . . . . Front Cover

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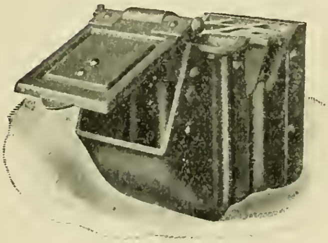

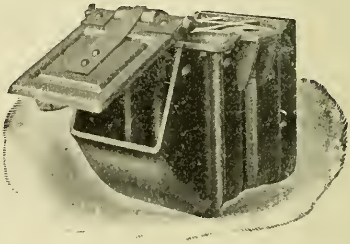

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VOL. X. No. 5. Pittsburgh, Pa., March 24, 1911. $1.00 Per Year 20c Per Copy

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Meetings held fourth Friday each month, except June, July and August.

PROCEEDINGS OF MEETING,
MARCH 24th, 1911.

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8:00 o'clock P. M., with President F. R. McFeatters in the chair.

The following gentlemen registered:

MEMBERS.

Alleman, Chas. W.
Amsbary, D. H.
Anderson, J. B.
Barth, John W.
Beatty, E. A.
Bell, W. K.
Beltz, J. D.
Bennett, R. G.
Black, F. J.
Boyer, Chas. E.
Boyle, Harry Edgar
Brewster, Morris B.
Briggs, I. O.
Brown, L. M.
Buchanan, A. H.
Chittenden, A. D.
Clark, C. C.
Clifford, M. J.
Cline, W. A.
Collins, C. R.
Conley, Clark C.
Courson, C. L.
Courson, J. F.
Crouch, A. W.
Dambach, C. O.
Dickinson, F. W.
Drake, W. C.
Drane, Edward J.
Dyer, J.
Elliot, A. H.
Evans, H. E.
Frost, John B.
Gallinger, Geo. A.
Gies, Geo. E.
Gray, Guy M.
Grewe, H. F.
Griswold, W. W.
Grooms, J. C.
Hall, C. W.
Harriman, Henry A.
Hillberry, H. H.
Hindman, S. M.
Howe, D. M.
Jenny, Jacob
Kennedy, Jas.
Keptner, J. B.
Keyser, R. H.
Kinney, M. A.
Kinter, D. H.
Klingensmith, W. H.
Kleine, R. L.
Knight, E. A.
Krause, Julius
Kurzhals, C. L.
Lanning, C. S.
Lanning, J. Frank
Lewis, A. J.
Lobez, P. L.
Lockhart, J. C.
Lowe, W. D.
Lynn, Samuel
Malloy, M. A.
Mason, E. F.
Mason, F. N.
Mason, Stephen C.
Matthews, J. A.
Mensch, E. M.
Mitchell, A. G.
Mowry, Jas. D.
McFeatters, F. R.
McGraw, Wm. P.
Nicol, George A.
Noland, J. J.
Oates, Geo. M.
Orner, Milton T. S.
Pape, Chas. F.
Pfeil, John
Porter, H. V.
Proven, John
Publow, John J.
Rabold, Wm. E.
Rauch, T. T.
Redding, D. J.
Robinson, J. R.
Ryan, W. F.
Sargeant, William A.

Schlacks, W. J.
Schoonover, W. H.
Simpson, M. S.
Smith, D. W.
Snow, W. T.
Snyder, Jos.
Stark, F. H.
Stewart, S. R. B.
Stucki, A.
Swann, J. B.
Symington, C. J.
Thomas, J. H.
Walker, J. W.
Walther, G. C.
Warne, J. C.
Wescoe, F. B.
Williams, W. W.

VISITORS.

Beck, W. H.
Beltz, Chas. E.
Benton, W. H.
Conway, Scott M.
Daughbaugh, L. W.
Ferree, H. W.
Forsythe, Geo. B.
Garratt, L. W.
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Smith, Sion B.
Staley, P. C.
Stark, J. L.
Sterret, C. E.
Taylor, Frank C.
Vonach, Albert L.
Von Schlick, H. H.
Weiss, W. W.
Young, C. D.

PRESIDENT McFEATTERS: The minutes of the last meeting are in the hands of the printer, and we will omit the reading of them.

It is quite likely that some of the members will think we made the change of meeting place rather suddenly from the Fort Pitt Hotel to the Monongahela House. But the Executive Committee went into the matter carefully and decided to make the change at once on account of lack of suitable room at the former hotel. We have realized for some time that the meeting place was not large enough to accommodate those who wished to attend our meetings, and at the last meeting there were probably a hundred members turned away who could not gain admittance because the room was already full. That precipitated the immediate decision to change the place of meeting to more commodious quarters.

The Secretary read the following applications for membership:

Brown, Alexander M., General Manager, Zug Iron & Steel Co., Thirteenth and Etna Sts., Pittsburgh, Pa. Proposed by Francis L. Arensberg.

Bruck, Henry T., Supt. Motive Power, Cumberland & Pennsylvania R. R., Mount Savage, Md. Proposed by M. O'Connor.

Clark, E. J., Supervisor of Signals, P. R. R. Co., East Liberty, Pa. Proposed by J. H. Gumbes.

Clifford, M. J., General Yard Master, Monongahela R. R., Brownsville, Pa. Proposed by D. H. Kinter.

Demko, John H., Bookkeeper, Universal Portland Cement Co., 1132 Washington St., Braddock, Pa. Proposed by J. M. Warfield.

Drane, Edward J., Assistant Chief Clerk, Car Record Office, Penna. Lines West of Pittsburgh, 184 Sheridan Ave., Bellevue, Pa. Proposed by Allan Neilson.

Dudley, G. W., Electrician, P. R. R. Co., Thirty-second and Carson Sts., Pittsburgh, Pa. Proposed by M. A. Malloy.

Flaherty, P. J., Manager, American Car & Ship Hardware Mfg. Co., New Castle, Pa. Proposed by J. A. Gearhart.

Flanigan, A. C., Freight Agent, P. & L. E. R. R. Co., Coraopolis, Pa. Proposed by A. D. Smith.

Goff, John P., Yard Master, P. & L. E. R. R. Co., 118 Mill St., Coraopolis, Pa. Proposed by F. H. Stark.

Gray, G. B., Signal Inspector, Penna. Lines West of Pittsburgh, Union Station, Pittsburgh, Pa. Proposed by D. C. Courtney.

Hauger, D. M., Chief Clerk to Superintendent, P. & L. E. R. R. Co., General Office, Pittsburgh, Pa. Proposed by C. W. Alleman.

Hickey, A. F., Chief Clerk, The Canfield Oil Co., Coraopolis, Pa. Proposed by A. D. Smith.

Hollein, Wm., Engineer, Power Plant, P. R. R. Co., Thirty-second and Carson Sts., Pittsburgh, Pa. Proposed by M. A. Malloy.

Howe, Dean, Assistant Chief Electrician, Universal Portland Cement Co., Universal, Pa. Proposed by J. M. Warfield.

Isler, J. C., Chief Time Clerk, Monongahela R. R. Co., Brownsville, Pa. Proposed by C. O. Dorr.

Leonard, P. G., Road Foreman of Engines, Hocking Valley R. R., Columbus, O. Proposed by A. W. Crouch.

Lockard, Joseph A., Clerk, P. R. R. Co., 7236 Race St., Homewood, Pa. Proposed by Chas. E. Boyer.

Marshall, James H., Master Mechanic, Universal Portland Cement Co., Box 924, Homestead, Pa. Proposed by J. M. Warfield.

Milner, B. B., Foreman, Penna. R. R. Co., Broad Street Station, Philadelphia, Pa. Proposed by E. S. Chapin, Jr.

McClellan, A. W., Supervisor, Penna. R. R. Co., Trafford, Pa. Proposed by Wm. Elmer.

Niemeier, C. H., Division Engineer, Penna. R. R. Co., Union Station, Pittsburgh, Pa. Proposed by Wm. Elmer.

Phillips, Lee, Rep. National Radiator Co., Carnegie, Pa. Proposed by A. D. Smith.

Rivinius, Carl, Piece Work Inspector, Penna. R. R. Co., Pitcairn, Pa. Proposed by J. F. Courson.

Rohn, W. B., Chief Clerk, Pressed Steel Car Co., Farmers Bank Building, Pittsburgh, Pa. Proposed by M. S. Simpson.

Staley, P. C., Assistant Master Mechanic, P. R. R. Co., Thirty-second and Carson Sts., Pittsburgh, Pa. Proposed by M. A. Malloy.

Thurber, Guy P., General Manager, Gray-Thurber Signal Co., Jenkins Building, Pittsburgh, Pa. Proposed by D. C. Courtney.

Von Schlick, Henry H., Salesman, Gray-Thurber Signal Co., Jenkins Building, Pittsburgh, Pa. Proposed by D. C. Courtney.

Weiss, W. W., Secretary, Gray-Thurber Signal Co., Jenkins

Building, Pittsburgh, Pa. Proposed by D. C. Courtney.

PRESIDENT McFEATTERS: When these applications have been favorably passed upon by the Executive Committee the gentlemen will become members.

We have before us tonight the report of our Standing Committee on Interchange Rules. I will ask the Chairman to read the report and I will also ask you to pay particular attention to the report and be ready to criticise it or offer suggestions when he has finished. Mr. Kleine, will you read the report:

REPORT OF STANDING COMMITTEE ON REVISION OF M. C. B. RULES OF INTERCHANGE.

Mr. President and Gentlemen:—The 1910 M. C. B. Rules of Interchange were carefully considered at a meeting of your Committee held at the Fort Pitt Hotel, Pittsburgh, March 7th and 8th, 1911, at which all the members of the Committee were present, and the report for suggested revision or additions is appended. All suggestions received were given careful consideration and while there are, apparently, a number of minor modifications recommended in the rules, upon analysis it will be found that they are intended to clear up questionable features in the rules. The suggestions of members which have not been included in the report did not receive favorable consideration by your Committee.

The rules in general have proven very satisfactory and, therefore, no radical changes are suggested.

Your Committee desires to express its appreciation for the arrangements and entertainment provided by the Club during their meeting.

RULE No. 4.

Add new paragraph, viz: "Defect cards shall not be required for any damage so slight that no repairs are necessary, the receiving road to be the judge."

This addition is to discourage the practice of some inspectors demanding defect cards for any and all damage caused by unfair usage regardless of repairs being necessary. If the damage is of such a nature that no repairs will be made defect cards should not be demanded as no use will be made of these defect cards even though they be issued. Provision has, however, been made that the receiving road should be the judge.

RULE No. 5.

After the word "be" in the first line add the word "cardboard."

This addition in the rule covering defect cards conforms to Rule No. 8 requiring that the repair card to be tacked on the car shall be of cardboard. In some instances defect cards have been issued consisting of ordinary paper printed on both sides in black ink instead of red ink, and the paper being of a flimsy character it cannot be maintained on the car until repairs are made.

RULE No. 9.

Fourth paragraph. Change the word "open" to "slotted" and the word "closed" to "solid."

Explanation: The terms "open and closed knuckle" are incorrectly used, as they have reference to slotted and solid knuckles.

After reference to metal brake beams add "and kind of beam." (Sixth paragraph.)

Explanation: To enable owners to check whether a No. 1 or No. 2 beam has been properly used in repairs.

Add to this rule the following paragraphs for the reason that this rule is supposed to cover the information which must be specified on the repair cards and does not specify, at the present time, all the information that is required to be added to the repair cards. By making these additions it avoids the necessity of returning bills for correction:

1st. When foreign cars are re-light-weighed it must be so stated on the repair card showing the weight before and after light-weighing.

2nd. When bill is to be rendered for adjusting the height of cars, the height of the car before and after altering must be shown on the repair card. (See Rule No. 20.)

3rd. When M. C. B. Standards are substituted for the original construction, the kind of material used must be shown on the repair card. (See Rule No. 17.)

4th. When doors are renewed it must be plainly stated on the repair card the kind of doors, as per Rule No. 104.

5th. When end sills are replaced it must be plainly stated on the repair card whether inside or extended end sills.

6th. Kind of triple valve removed and applied.

Explanation: To enable the owner to ascertain whether the same type of triple valve has been replaced.

7th. When triple valve or cylinder is cleaned initial of road and date of last cleaning must be shown.

Explanation: To enable owner to check up air brake work.

8th. M. C. B. air hose whether new or second-hand.

Explanation: Rule 62 requires that new hose must be used when chargable. The addition is recommended to enable the owner to properly check the bill.

RULE No. 12.

Add to last line: "And signed only by the parties making the actual inspection."

To provide that the joint evidence card will be signed by the parties who made the actual inspection.

RULE No. 14.

Add to the end of second paragraph "See Rules 5, 7, and 12."

To more clearly define that the location of parts relates to the defect, repair and joint evidence cards.

RULE No. 17.

Add to the end of last paragraph: "Fir or oak may be substituted for pine when splicing longitudinal sills."

In some cases objection has been made to the substitution of fir and oak for pine in making splices on longitudinal sills. This substitution should be allowed.

Add two additional paragraphs to this rule, as follows:

1st. "In repairing or renewing brake shafts they must not be welded."

To conform to Interstate Commerce Commission Standard Specifications.

2nd. "In cleaning and repairing triple valves the triple valve standard to the car must be replaced."

To provide for the proper maintenance of improved types of triple valves.

RULE No. 18.

Third paragraph, fourth line, change the word "Replaced" to "Repaired" and omit the last clause reading: "Except cars offered in interchange."

When couplers exceed the distance of 5⅛" between point of knuckle and guard arm they are usually brought within the limits by the renewal of the knuckle pin, locking pin, knuckle or a combination of these parts, therefore, it is unnecessary to replace the coupler, but repair the same.

The omission of the words "Except on cars offered in interchange" is recommended as this is purely an owner's defect and should be chargeable to the owner whenever repairs are made. Unless the couplers on the car are free and not coupled to an adjacent car the distance between the point of knuckle and guard arm cannot be measured, and, therefore, it would be impracticable to hold the delivering company responsible for this defect on cars offered in interchange.

RULE No. 19.

Change the word "Open" in third paragraph to "Slotted," for the same reason as given under Rule No. 9.

RULE No. 21.

Add to the end of this rule: "Or for making temporary repairs to cars sent home on home route cards as per Rule No. 124."

It is the general practice to charge the car owner for making temporary repairs in order to place cars in condition to send them to the owner on home route cards and in order that the practice may be generally understood the above addition to Rule No. 21 is recommended.

RULE No. 22.

The revision of Rule 22 covers the following changes in the practice of splicing sills:

1st. Permits splicing of all longitudinal sills at both ends of the car with a proviso that not more than two adjacent sills may be spliced at the same end of car. According to the present rule all longitudinal sills with the exception of center sills may be spliced once and center sills may be spliced at both ends of the car. Service conditions have shown that it is safe to splice cars in conformity with this rule at one end of car, and, therefore, the same practice should be allowed at both ends of the car.

2nd. The center sill splice is changed to conform to the half butt splice shown in figure 9-B. On account of the short distance between the body bolster and cross-tie timber on many cars it is impossible to splice the sill and stay away 24″ from the cross tie timber. With the half butt splice it is considered entirely safe to splice close to the cross-tie timber, and the rule has been changed to cover this.

3rd. The splicing of center sills on foreign cars shall conform to the half butt splice as shown in figure 9-B. At present the center sills of foreign cars must be spliced to conform to the scarf form of splice shown in figure 9-A. The M. C. B. Committee appointed to investigate this subject determined by tests that the form of splice shown in figure 9-B is very much stronger than that shown in figure 9-A, for which reason the change is recommended.

4th. All longitudinal sills, excepting center sills, may be spliced with either the scarf or half butt splice. At present the rules require that all longitudinal sills, except center sills, must be spliced with the scarf splice.

5th. Provision is also made that cars will be accepted in interchange with center sills spliced in accordance with the scarf form of splice shown in figure 9-A.

Change first paragraph of Rule No. 22 as follows: "Draft timbers must not be spliced. Longitudinal sills may be spliced at both ends, except that not more than two adjacent sills may be spliced at same end of car. The splicing of any sills between cross tie timbers will not be allowed."

Change last line of second paragraph, page 11, to read as follows: "And not within 24 inches of body bolster."

Paragraph 3. Add in third line, after figure 8, the words "Or figure 9-B." Add in fifth line after figure 9 the words "Or figure 9-B." In last line change 9-A to 9-B.

Change fifth paragraph to read: "Cars delivered in interchange with center sills spliced as shown in figure 9-A will be acceptable."

RULES Nos. 30 and 31.

Rule No. 30: Strike out last clause of first paragraph of this rule reading: "And owner notified of old and new weights."

Rule No. 31: Add a new paragraph as follows: "Reports of all cars light-weighed and re-stenciled as per Rules 30 and 31, whether chargeable or not, must be made promptly when work is done, to the road owning the car, in addition to showing this information on the repair card."

It is essential that owners should receive prompt notification of any changes in the light-weight of their cars, and the re-weighing of the cars is made necessary on account of the repairs which the car may receive under the M. C. B. Rules of Interchange. While it is true that this information is shown on the repair card, the repair card very often does not reach the owner until several months have elapsed after the work has been done, for which reason provision is recommended that the owner be promptly notified of any changes in light-weight of car in addition to showing this information on the repair card.

RULE No. 32.

Add to the end of this rule the words: "Except for damage so slight that no repairs are necessary, the receiving road to be the judge in cases of this kind."

For the same reason as given under Rule No. 4.

RULE No. 35.

Add to the end of Rule No. 35: "Cars equipped with friction draft gear and so stenciled if found with spring draft gear. Cars equipped with tandem spring pocket and so stenciled if found with single spring pocket."

Cases are found where friction draft gears have been removed and spring gear substituted, also where the tandem spring pocket has been removed and a single spring pocket substituted and no repair cards or bills made out to cover the work done, thus depriving the owner of the maintenance of this essential part of the equipment. As wrong repairs of this kind are self-evident on inspection it is recommended that the delivering company be made responsible.

Heading: Combination of Damages.

The effect of unfair usage on the steel underframes of cars with wooden superstructure as well as on cars of all-steel construction is so different on these cars as compared with wooden cars that we would recommend that the combination damages which denote unfair usage on wooden cars be separated from the combinations which denote unfair usage on steel cars, and to accomplish this we suggest the following change in the heading for Rules 37 to 43 inclusive, and the addition of a new rule covering delivering company's responsibility for damage to all-steel and steel underframe cars:

Heading for Rules 37 to 43 inclusive changed to read: "Combination of damages to cars with wood underframe or composite wood and metal underframe which denote unfair usage if existing at the same end of car. (See Rules 37 to 43 inclusive.)"

RULES Nos. 37 to 43 Inclusive.

Rules 37 to 43 inclusive have been modified to extend the combinations of damages with the idea that the end sill in addition to the coupler body and one draft timber or its substitute must be broken before a combination exists. At the present time the delivering company is responsible if the coupler body is damaged and a defective draft timber is renewed at the same time. or if a coupler body is damaged and a defective end sill is renewed at the same end of car. The Arbitration Committee has decided that where a draft timber or end sill is renewed in connection with a defective coupler, irrespective of the previous condition of the draft timber or end sill, the delivering company is responsible. This decision was practically made necessary on account of the disputes arising due to the previous condition of these parts, irrespective as to whether or not these parts were weakened by age or decay. The recommended changes relieve the delivering company of responsibility when the coupler body and one draft timber or its substitute is broken, or when the coupler body and one end sill at the same end of car is broken. The delivering company is responsible for a coupler, draft timber or its substitute, and end sill if broken at the same end of car.

The second change involves the extension of the combination to include two longitudinal sills broken accompanied by damage to end sill. At the present time the delivering company is responsible for a damaged end sill accompanied by damage to one longitudinal sill.

When repairing a longitudinal sill, in many cases, it is found that the end sill is defective or broken due to age or decay, and it is a direct benefit to renew the end sill at the time the longitudinal sill is spliced or renewed. If rough handling exists usually both center sills are broken and under the revised rule two longitudinal sills and an end sil' are broken and the delivering company is still responsible.

Thirdly, it is recommended that where a missing coupler would enter into the combination it will be assumed that the missing coupler is not damaged, whereas, at the present time the rules prescribe that, unless shown to the contrary, the missing coupler and attachments will be considered damaged. Present Rule No. 97 in cases of missing couplers provides that labor only may be charged in replacing such couplers, therefore, assuming that these missing couplers are not damaged. That this assumption is correct is proven by the fact that in over 90% of the cases of couplers pulling out that are eventually picked up and brought to the shop they are found in good condition. In order to expedite the repairs to foreign cars the time is not available to investigate and ascertain whether missing coupler is or is not broken, and if under the rules it is proper to assume in one case that the missing coupler is not damaged, the same conclusions should be reached in all cases of missing couplers.

RULE No. 37.

Change the word "or" in third line to "and."

RULE No. 38.

In second line omit the word "either" and in third line change the word "or" to "and."

RULE No. 39.

Change to read: "Damaged draft timber (or its substitute) accompanied by damage to end sill and coupler body or coupler pocket."

RULE No. 40.

Omit as the same is covered in Rules Nos. 37, 38, 39 and 41.

RULE No. 41.

Change to read: "Damaged end sill accompanied by damage to two or more longitudinal sills."

RULE No. 43.

First paragraph, second line, omit the words "Or repairs to."

In many cases it is found that the two end posts including the pockets are pushed out from the inside by the lading, which is directly due to insufficient heel for these end posts. There is no rough handling present and this does not occur where the end posts are properly secured, therefore, the delivering company should not be held responsible where the end posts are displaced if not broken.

Second note, change to read: "It will be assumed that a missing coupler and attachments are not damaged. This refers to cases where the coupler if broken would enter into the combination of defects."

Add new heading and additional rule after Rule No. 43.

(Heading)

"Damage to Bodies of All-Steel or Metal Parts of Steel Underframe Cars."

(New Rule)

"Damage to bodies of all-steel or metal parts of steel underframe cars if caused by unfair usage, when necessary to repair (Delivering Company responsible).

"Longitudinal sills, end sills and other steel parts of cars which become defective due to corrosion or service conditions, and which were not damaged in accident or by unfair usage (Owner responsible)."

Note: When repairs exceed the combinations as covered by Rule Nos. 37 to 43 inclusive owners' authority must be obtained before repairs are made.

RULE No. 47.

Change to read as follows: "When two or more cars chained together with switch chains and couplers blocked out with metal spacing blocks are delivered at an interchange point; the receiving road shall deliver to the delivering road at the time, an equivalent number of switch chains and metal spacing blocks of the same size as the chains and blocks used on the cars delivered, or in lieu thereof furnish a defect card for such chains and metal spacing blocks."

This rule has been changed to include metal spacing blocks as Rule No. 26 of the Loading Rules requires metal blocks to be applied. These Loading Rules are an M. C. B. Standard and now a part of the Interchange Rules, therefore, Rule No. 47 of the Interchange Rules should be consistent with the Loading Rules and protect the road applying metal spacing blocks when such cars are offered in interchange.

RULE No. 52.

Change third paragraph to read: "Hand holds or grab irons must be of wrought iron or steel. Handholds, ladders and sill steps, when replaced in repairs, must be secured by bolts or rivets."

To conform to United States Safety Appliance Standards.

RULE No. 53.

Add to this rule two new paragraphs as follows:

1st. "After September 1st, 1912, all freight cars offered in interchange not equipped with pressure retaining valves, Delivering Company responsible"

Rule No. 61 at the present time makes the owner responsible for all cars not originally equipped with retaining valves. Cases have been found where retaining valves have been applied to cars where there was no evidence whatever of the car having previously been equipped with retaining valves. When bill was rendered for the work done the owner refused to honor same, claiming that the car had originally been equipped with retaining valve, and that the road making repairs should have protected itself by demanding a defect card for the missing retaining valve and pipe when the car was received on its line. Under the present rules the delivering company refuses to issue a defect card where there is no evidence of the car having originally been equipped with retaining valves, claiming that the retaining valve can be applied and the owner billed. The retaining valve is a necessary adjunct to the air brake in operating cars in interchange and to cover the matter and avoid disputes the above recommendation is made.

2nd. "After September 1st, 1912, no cars will be accepted in interchange unless equipped with M. C. B. standard 1¼ inch train line, angle cocks and quick action triple."

To provide for the proper interchangeability of the air brake parts and the proper working of the air brake in long trains.

RULE No. 57.

Add after the words "Triple valves" the words "Brake pipe air strainer or dirt collector."

This particular part of the air brake equipment is at present omitted from the rule and shoud be covered.

RULE No. 59.

In third line, add the word "Corrosion" after the word "Seams."

Leaky pipes due to corrosion is strictly a car owner's defect and should be covered in the rules.

RULE No. 60.

Add after the word "The" in third line "Initial of road together with."

Add at end of rule "Triple valves cleaned must be tested on an M. C. B. test rack to permit billing."

This rule together with arbitration decision makes the owner responsible for the cleaning, oiling and testing of cylinder and triple valve regardless of how frequently it may be executed. It is suggested to stencil the initial of the road doing the cleaning on the air brake cylinder or auxiliary reservoir in addition to the date the work is done, so as to enable the owner to check up and locate bad workmanship. It is further recommended that triple valves must be tested on an M. C. B. test rack in order to permit billing, so as to insure triple valves applied to foreign cars on account of cleaning or repairs being in proper serviceable condition. Unless such triples are submitted to the standard M. C. B. test proper service efficiency will not be attained.

RULE No. 66.

Add paragraph to this rule as follows: "After September 1st, 1915, cars equipped with wooden or trussed wooden brake beams will not be accepted in interchange."

This recommendation is made on account of the trouble experienced with the failure of wooden and wooden trussed brake beams. To enable the owners to retire these beams from service a liberal extension of time as to when this rule would go into effect is recommended.

RULE No. 70.

Change to read: "Cars equipped with forged steel or steel tired wheels and so stenciled, if found with cast iron or cast steel wheels."

"Forged steel or steel tired wheels may be substituted for cast steel wheels."

The rule as it reads at present has been revised to fully cover the intent of the meaning, that is, that cast iron or cast steel wheels cannot be substituted for rolled steel or steel tired wheels. On account of the price of the cast steel wheel the rule is recommended to be extended so that cast iron wheels cannot be substituted for cast steel wheels, but that handling roads will be privileged to substitute rolled steel or steel tired wheels for cast steel wheels in repairs.

RULE No. 75.

Omit the following words: "Flange over 1 7/16 inches thick for cast iron wheels, standards of 1903, 1904, 1905 and 1906. (See figure 6), or."

There are no new wheels of this obsolete design on hand and, therefore, the rule should be eliminated.

RULE No. 83.

Beginning with the sixth line omit the following: "For all wheels cast prior to the M. C. B. tread and flange adopted in 1907 shall be made by a gauge shown in figure 6, and."

Figure 6, page 34, omit.

For the reasons as explained under Rule No. 75.

Figure 9, page 37. The minimum dimension between backs of flanges should be changed from 4′ 5 5/32″ to 4′ 5 3/32″.

This dimension was changed to 4′ 5 5/32″ by the Arbitration Committee last year on a recommendation from the Railway Club of Pittsburgh, and the same was in error. The distance of 4′ 5 5/32″ is the dimension between backs on the mounting gauge, but the inspector's gauge which controls the wheels in service has a minimum of 1/16″ less than the mounting gauge, and, therefore, the correct dimension should be 4′ 5 3/32″.

RULE No. 88.

Change the word "Shall" in second line to "Must."

It is desired that where wrong repairs are made the defect cards covering such wrong repairs be tacked to the car and it is thought that the word "Must" more definitely explains the intention than does the word "Shall," as at the present time the defect card is not always placed on the car in cases of this kind.

RULES Nos. 91 and 92.

Eliminate these two rules.

Switching lines should be allowed to render bills for repairs made on account of car owner's defects without first obtaining joint evidence on cars delivered to such lines. The present requirement is a source of delay in the interchange of cars.

RULE No. 96.

Eliminate Rule No. 96.

Rule No. 96 provides that the billing repair card must accompany the bill, and as this is fully covered in Rule No. 93, Rule No. 96 can be dropped.

RULE No. 99.

Page 44, fourth line, refers to page 81 which should be changed to page 83, which is the page on which the information required is given.

RULE No. 101.

Omit in table on page 44 the scrap price for 33″ cast iron wheels, and in place thereof substitute a uniform credit price of $5.50, also omit the scrap price for 36" cast iron wheels and in place therof substitute a uniform credit price of $6.00.

It is very difficult for the inspector at the shops removing a pair of cast iron wheels from a car to determine properly whether the wheel which is not defective is or is not good for further service, his judgment very often being reversed at the wheel press as the question of taping of wheel, wear of tread and size of wheel fit must be taken into consideration when remounting second-hand wheels. For this reason the practice of crediting wheels as second-hand or scrap is not uniform on different roads. A record was kept of a total of 800 pairs of wheels and it was approximately found that one-third of them were good for further service. It would be entirely equitable to all the roads to credit all wheels removed from foreign cars at a uniform credit price, and when applying second-hand wheels to foreign cars the second-hand price to be used. The recommended credit price of $5.50 for 33" and $6.00 for 36" wheels is based upon the above figures.

Third paragraph, page 45. Add after the word "Having" at the end of second line the words "Flanges 1 15/64 inches thick and," also add after the word "Having" in sixth line of same paragraph the words "Flanges 1 15/64 inches thick and."

The above recommendation requires that new wheels applied must have at least a normal flange thickness.

Page 46, omit second heading "Delivering Line Defects" as this is a repetition.

RULE No. 104.

Air Brake Material:

		8-inch.	10-inch.
1.	Release valve handle	.10	.10
2.	Release valve rubber seat..........	.02	.02
3.	Release valve vent valve, complete.	.10	.10
4.	Omit item "Triple cylinder bushing renewed"........................	1.12	1.12

Explanation:

Item No. 1, Release valve handle for 8" and 10" equipment are identical, therefore, price should be the same.

Items Nos. 2 and 3 are additions.

Item No. 4 was recommended last year as "Triple cylinder bushing reground or refitted" and should properly be placed under Rule No. 115, as Rule No. 104 covers material charges only.

Other Material Prices:

Coupler body, one, new, steel, 5 x 5" shank, $5.75 instead of $6.50.

Coupler body, one, new, steel, 5 x 7" shank, $6.50 instead of $7.75.

Coupler knuckle, one, new, solid, $2.25 instead of $2.00.

Coupler lock, one, new, 50 cents net instead of charge 40 cents, credit 6 cents.

No other changes in scrap credits.

It will be noted that the price for coupler bodies has been reduced and the prices for solid knuckle and coupler lock have been advanced. These changes in prices of the detail parts will correspond more closely with the cost of these parts, as well as compare with the total cost of the complete coupler. The prices as quoted are average prices taken from 14 different makes of couplers and include freight charges as well as cost of handling.

Page 49: Coupler knuckle, one, new, open—change the word "Open" to "Slotted."

Page 50: Omit item, "Handhold, one, applied, net 25 cents" and substitute the following:

Handhold, or ladder tread, one, renewed, or first application, with bolts, where lining or roofing boards are not removed and replaced, net 30 cents.

Handhold, or ladder tread, one, renewed, or first application, with bolts, where lining is removed or replaced including filler block, net 50 cents.

Handhold, or ladder tread, one, renewed, or first application, with rivets, net 40 cents.

Handhold, roof, one, renewed, or first application, where it is necessary to remove and reapply roof boards, net 75 cents.

Note: Handhold prices do not cover handholds or ladder treads applied to refrigerator cars or tank cars, for which actual cost should be charged.

Explanation: According to the United States Safety Appliance Standards it is not permissible to secure handholds or ladder treads by means of lag screws and the above prices, based on actual average cost, are recommended to cover the application of handholds and ladder treads by means of bolts.

RULE No. 111.

The following changes or additional are recommended:

	Ordinary Cars. Hours.	Refrigerator Cars. Hours.
1. Arch bar, blacksmith shop labor, each repairing...........	1½	1½
2. Bolster body, metal, one, replaced when draft timbers extend through same	16	18
3. Page 53, item 18, change to read: "Carrier iron bolts, 6 inches long or less, each".....	¼	¼
4. Page 53: Add after item reading "Column bolts, etc.," the following item: "Column castings, one or both, replaced on same side of truck:		
When bolted to spring plank..	3	3
When riveted to spring plank	4	4
5. Column castings, two replaced on opposite sides of same truck:		
When bolted to spring plank..	5	5
When riveted to spring plank	6	6

6.	Page 58, last item in table, change to read: "When necessary to remove load to make repairs at one end of car.....	3	3

Explanation:

Item No. 1: The blacksmith shop labor for repairing each arch bar is the same, therefore, the price should be modified to cover each arch bar.

Item No. 2: The price for replacing metal body bolster when draft timbers extend through the same has been increased from 8 to 16 hours for ordinary cars and from 10 to 18 hours for refrigerator cars. It is necessary to take down these through draft timbers in order to replace the metal body bolster. 13 hours are now allowed for replacing the draft timbers that extend beyond body bolster, but as the work is overlapping 16 hours are recommended to do this work on ordinary cars and 18 hours for refrigerator cars.

Item No. 3: Some of the short carrier iron bolts on steel cars measure 6 inches in length, and as the ¼ hour labor charge for replacing these bolts covers the work done it is recommended to increase the length of these bolts from 4″ to 6″.

Items Nos. 4 and 5: No prices are now shown in the rules for renewing column castings, for which reason the above prices are recommended which are in accordance with the prices for replacing arch bars.

Item No. 6: This item in the rules does not cover all of the cases where it is necessary to remove the load and make repairs, such as handholds, pin lift casting bolts, ladder bolts, etc., for which reason this change is recommended.

RULE No. 113.

Second paragraph: Change word "Four" in second line to read "Six."

For the same reason as given under explanation for Rule No. 111.

RULE No. 114.

Add additional paragraph as follows: "Applying brake hangers when brake beam is applied."

No additional labor should be charged when brake beam is renewed or replaced.

RULE No. 115.

Add item: "Cut out cock, grinding in, R. & R., 30 cents."

This item is not now covered in the rules.

Page 65: The following suggestion is made to add below third item on this page: "Triple cylinder bushing, reground or refitted, $1.12."

For the reason given under Rule No. 101.

Page 65, third item, change price of "Triple piston packing ring, fitted" from 17 cents to 22 cents.

This work cannot be done for the price now given.

Add new item as follows: "Dirt collectors in branch pipe cleaned and drained, 2 cents."

RULE No. 125.

Add a new paragraph reading as follows: "In the case of a steel underframe car having superstructure destroyed on a foreign line, upon regular request the owner shall accept the car for the repairs provided the underframe is not seriously damaged."

The rebuilding of the superstructure of steel underframe cars must be in accordance with the drawings of the original construction of the car. In cases where the entire superstructure is destroyed it would save time and avoid wrong repairs being made by returning the underframe to the owner for application of the superstructure.

Respectfully submitted:

G. E. CARSON,
New York Central & Hudson River Railroad.

S. A. CROMWELL,
Baltimore and Ohio Railroad.

F. W. DICKINSON,
Bessemer and Lake Erie Railroad.

G. N. DOW,
New York Central Lines.

W. J. KNOX,
Buffalo, Rochester & Pittsburgh Railroad.
J. KRAUSE,
Pennsylvania Railroad, Lines East of Pgh.
A. LA MAR,
Pittsburgh, Ft. Wayne & Chicago Railway.
S. LYNN,
Pittsburgh and Lake Erie Railroad.
J. B. SWANN,
P. C. C. & St. L. Railway.
F. M. McNULTY,
Monongahela Connecting Railroad.
F. H. STARK,
Montour Railroad.
R. L. KLEINE, Chairman,
Pennsylvania Railroad, Lines East of Pgh.

PRESIDENT: Gentlemen, you have heard the report. It is now open for discussion. If there is no discussion, a motion to adopt it as a whole will be entertained.

MR. KLEINE: Before a motion of that kind is made I think we should have a full discussion of the new rule in regard to damage to all steel and metal parts of steel underframe cars. We should at least get an expression for or against the rule.

MR. D. J. REDDING: I have no criticism of the rules to offer at all, but it occurred to me that Mr. Kleine's calling attention to this new rule ought to bring out some discussion. The time has come when steel cars are getting to the point where they are wearing out in parts on account of corrosion, and perhaps if Mr. Kleine would tell what their experience has been, whether they are finding freight cars of that kind on the line which should be repaired, it might start the discussion.

MR. KLEINE: The reason for suggesting this rule came about in this way: There are a number of cars that were built with center sills, side sills and light floor sheets, and, in some cases, due to corrosion, the cars go down on the end, through no fault whatever of the handling road, but the cars are generally in that condition. Of course, under the present rules they form a combination of defects, and the result is that the cars are held until the owner can inspect them. The owner inevitably gives authority to the road having the car in its possession to make the repairs, and it is cases of that kind which have led the Committee to suggest this rule. The thought was to start this rule this year and add to it in other years as experience may dictate, so that finally we will have some rules covering combinations of defects on steel cars.

MR. F. H. STARK: Rule 70 is very well written and perhaps needs no additional explanation. Yet for my personal information I would ask Mr. Kleine for a proper interpretation of that rule as to the right practice and how it will affect a road that uses a cast steel wheel as their standard.

MR. KLEINE: At the present time Rule 70 does not cover cast steel wheels. In other words, the owning road has no protection for their cast steel wheels when offered in interchange, excepting the wrong repair proposition. It was thought on account of the high cost of the cast steel wheel that something should be placed in the interchange rules to protect the car owner who uses them. For which reason we suggest the second paragraph in Rule No. 70, "Forged steel or steel tired wheels may be substituted for cast steel wheels." That will prohibit a road from putting in cast iron wheels for cast steel wheels, but it gives the privilege of using forged steel or steel tired wheels in place of cast steel. The idea was that the cast steel wheel is not generally used by all railroads, but the forged steel wheel is in more common use, and this will protect the owner and at the same time permit the handling road to substitute a forged steel wheel for a cast steel wheel.

MR. REDDING: I move that the report and recommendations of the Committee be adopted as read.

MR. STARK: I second the motion of Mr. Redding.

(The motion was thereupon put to vote and carried unanimously.)

PRESIDENT: Gentlemen, there will be lunch served in the main dining room down stairs, which will be ready in a few minutes. A motion to adjourn will be entertained.

MR. REDDING: I want to move before we adjourn that a hearty vote of thanks be extended the Committee who compiled this report for their untiring efforts. They had considerable work during the past year in getting this information together, and I believe they are entitled to a vote of thanks from this Club.

PRESIDENT: Gentlemen, it has been regularly moved and seconded that a vote of thanks be extended to the Committee. What is your pleasure?

The motion was duly put to vote and carried unanimously.

PRESIDENT: Gentlemen, you have the thanks of the Club.

MR. KLEINE: We thank you, gentlemen.

There being no further business, ON MOTION, Adjourned.

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EDWARD KERR, President

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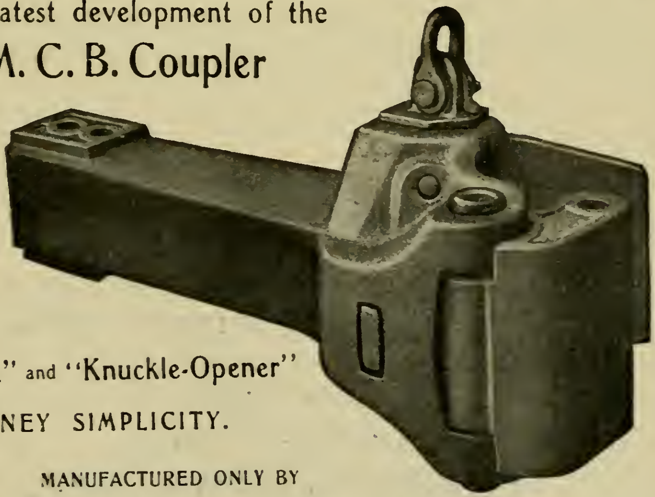

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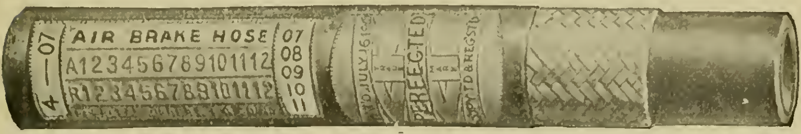

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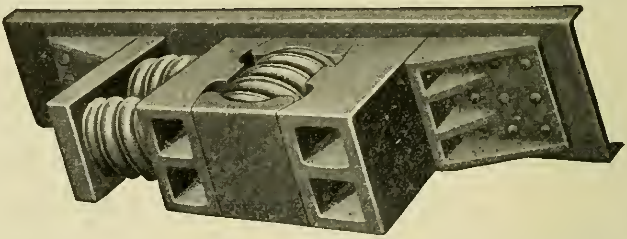

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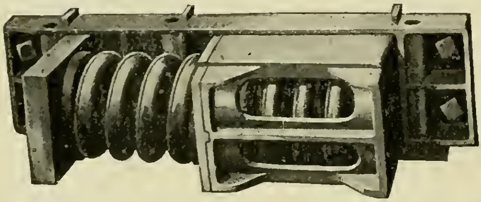

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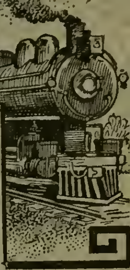

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Car Forgings
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BOILER TUBE ECONOMY

(*No. 1.)

MAINTENANCE COST

❡ In the September, 1910, issue of **The Boiler Maker**, economy in initial cost of Steel Boiler Tubes was conclusively demonstrated, amounting to a saving of from $180.00 to $240.00 per locomotive, and a comparative equal economy in tubes for stationary boilers.

❡ But the **initial** economy is not the whole story. In actual service it has been demonstrated that **The Modern Boiler Tube**—The Steel Tube—effects an economy in **maintenance cost** as well.

❡ In this connection we quote from the Official Proceedings of the International Master Boiler Makers' Association, held at the Hotel Seelbach, Louisville, Ky., April 27 to 29, 1909 (page 153). This is from a report submitted by the Foreman Boiler Maker of a large railroad in the Middle West.

> "One of the lines with which I am connected uses steel tubing for safe ends exclusively. Since the adoption of steel at this particular place they have increased their flue mileage at least 24 per cent. The maintaining and caulking of flues in engine house have been reduced the same proportion, 25 per cent. I have experienced no difficulty, whatever, in welding the steel safe ends to iron flues.
>
> "Below you will find a chart showing five passenger as well as five freight engines with mileage made with iron flues, as well as steel safe ends, we applied.

	Mileage Made Iron Flues.	Mileage Made Steel Flues.	Steel Over Iron.
1 passenger	60.299	108,478	48,179
1 passenger	96,273	103,330	7,059
1 passenger	41,684	115,723	74,039
1 passenger	50,128	87,524	37,396
1 passenger	84,561	120,088	35,527
1 freight	33,260	55,063	21,803
1 freight	39.390	76,788	37,398
1 freight	46.731	54,639	8,268
1 freight	30,614	59.967	29,353
1 freight	28,130	50,014	21,884

> "I will conclude by saying that my experience in this particular line with what I have been able to find in looking this matter up and also with the increased flue mileage in the above chart, I cannot help but say that we are coming to the use of steel flues very rapidly."

❡ Possibly your conditions are peculiar; that is, you may have bad water or there may be other unusual circumstances.

❡ We will be glad to receive correspondence relative to special difficulties in specific cases.

❡ Our experience is at your service.

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*This is the first of a series of announcements regarding **BOILER TUBE ECONOMY.**

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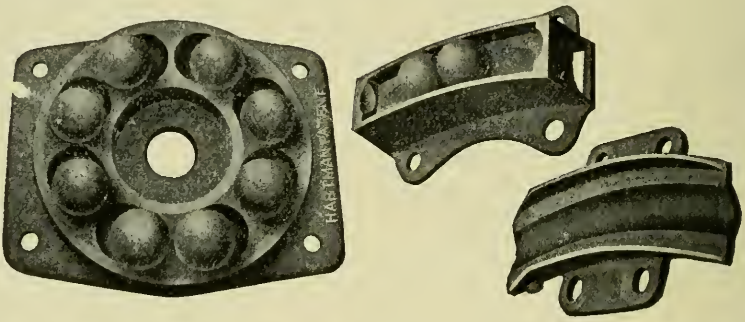

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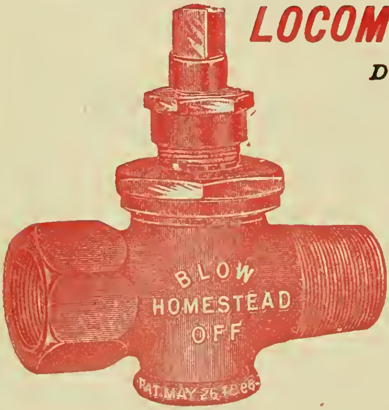

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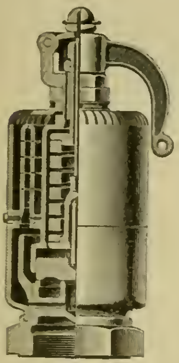

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Standard Locomotive Specialties
Make a Perfect Equipment.
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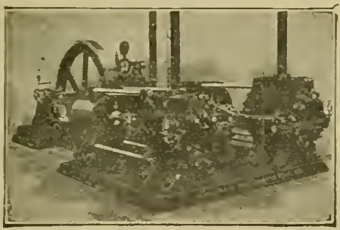

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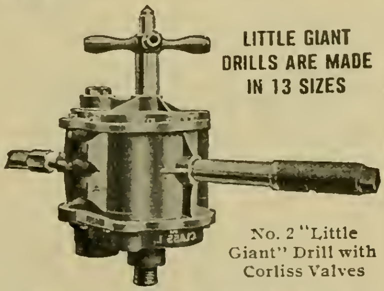

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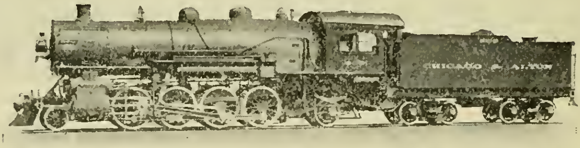

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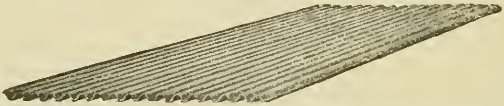

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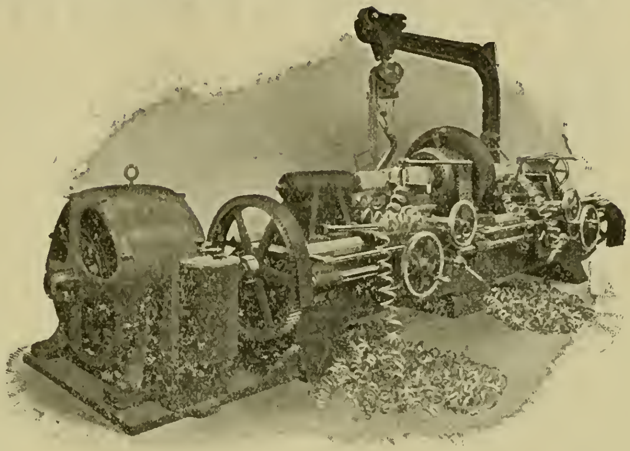

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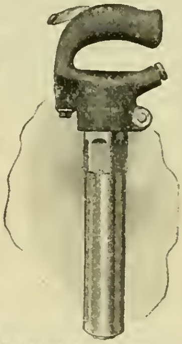

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Is a system of Automatic Train Control and Cab Signal which is designed to convey into the cab of a Steam Railroad Locomotive or an Electric Traction Car, the same character of signals now indicated ON THE SIDE OF THE TRACK by the Automatic Block Signal System in use on Steam Railroads—and together with the transmission of said signals into the cab of the engineer or motorman, the Gray-Thurber System of Automatic Train Control will, after sufficient opportunity has been given to the engineer or motorman to obey said signals himself, **absolutely automatically shut off the steam or electric power and apply the brakes,** should the engineer or motorman fail to do so.

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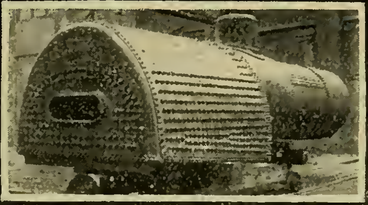

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INDEX—ADVERTISERS.

NAME	Page
American Brake Shoe & Foundry Co.	iii
American Locomotive Company	viii
Ashton Valve Co.	xi
Ball Chemical Co.	ii
Brady Brass Co.	Front Cover
Butler Drawbar Attachment Co.	xviii
Chicago Pneumatic Tool Co.	v
Clancy, J. R.	xvii
Cleveland City Forge & Iron Company	Front Cover
Crosby Steam Gage & Valve Co.	v
Damascus Brake Beam Co.	xvii
Dixon, Jos., Crucible Co.	vi
Flannery Bolt Co.	xi
Fort Pitt Malleable Iron Co.	xii
Franklin Manufacturing Co.	viii
Galena-Signal Oil Co.	xii
Gold Car Heating & Lighting Co.	vi
Gould Coupler Co.	ii
Gray-Thurber Automatic Train Control and Signal Co. of America	x
Homestead Valve Mfg. Co.	iv
Hunt-Spiller Mfg. Co.	xi
Ingersoll-Rand Co.	x
Lawrenceville Bronze Co.	xv
Lino Paint Co.	Back Cover
Long, Chas. R. Jr. Co.	iii
Magnus Metal Company	vi
Manning, Maxwell & Moore	iii
McConway & Torley Company	xv
Nathan Manufacturing Co.	iv
National Car Wheel Co.	iii
National Malleable Castings Co.	vi
National Tube Co.	i
Niles-Bement Pond Co.	ix
Page Woven Wire Fence Co.	Front Cover
Peerless Rubber Mfg. Co.	xvii
Pittsburgh Coal Co	iv
Pittsburgh Equipment Co.	Back Cover
Pittsburgh Testing Laboratory	Front Cover
Pressed Steel Car Co.	xx
Railway Steel Spring Co.	xvi
Safety Car Heating & Lighting Co.	xvi
Sipe, James B. & Co.	Front Cover
Standard Coupler Co.	xix
Standard Steel Car Co.	xviii
Steel Car Forge Co.	Front Cover
Suydam, M. B. Co.	Back Cover
Union Spring & Mfg. Co.	xiv
Union Steel Casting Co.	xix
Ward Equipment Co.	xix
Washington Coal & Coke Co.	ix
Western Railway Equip. Co.	Front Cover
Westinghouse Air Brake Co.	vii
Westinghouse Electric & Mfg. Co.	vii
Westinghouse Machine Co.	vii
Wood, Guilford S.	Front Cover

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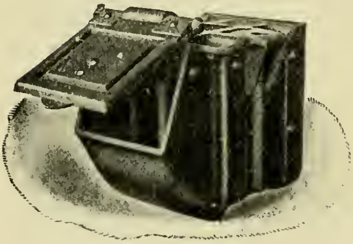

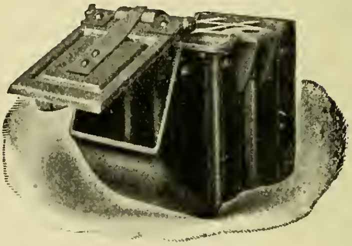

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of the

Railway Club *of* Pittsburgh.

ORGANIZED OCTOBER 18, 1901.

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Meetings held fourth Friday each month, except June, July and August.

PROCEEDINGS OF MEETING,
APRIL 28th, 1911.

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8:00 o'clock P. M., with President F. R. McFeatters in the chair.

The following gentlemen registered:

MEMBERS.

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Gies, Geo. E.
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Lynn, Samuel
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Matthews, J. A.
Mensch, E. M.
Mitchell, A. G.
Montgomery, H.
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Murphy, W. J.
McAdoo, John H.
McDermitt, W. W.
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McNaight, Arthur H.
McNulty, F. M.
Neylon, J. F.
Oliver, W. H.
Pfeil, John
Phillips, Lee
Pickels, H. D.
Porter, H. V.
Postlethwaite, C. E.
Rabold, W. E.
Redding, D. J.

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Rice, D. S.
Riley, Geo. N.
Rinehart, H. W.
Robbins, F. S.
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Ryan, W. F.
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Sargeant, William A.
Sargeant, L. L.
Sattley, E. C.
Schultz, Geo. H.
Sinclair, Angus
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Smith, Russell
Snyder, F. I.
Snyder, Jos.
Soles, G. H.
Speller, F. N.
Staley, P. C.
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Ryder, G. E.
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Smith, John B.
Smith, Sion B.
Sweeley, E. H.
Wieser, G. F.

The reading of the minutes of the last meeting was dispensed with, they having been printed.

The Secretary read the following list of applications for membership:

Artzberger, Lawrence C., Foreman, H. K. Porter Co., 5126 Dearborn St., Pittsburgh, Pa. Proposed by B. L. Tamkins.

Bailey, R. E. L., Chief Clerk, American Spiral Spring & Mfg. Co., Fifty-sixth St. and A. V. Ry., Pittsburgh, Pa. Proposed by W. W. Shields.

Barker, A. E., Salesman, Firth-Sterling Steel Co., 1422 Oliver Bldg., Pittsburgh, Pa. Proposed by F. M. McNulty.

Belleville, J. M., General Freight Agent, Pittsburgh Plate Glass Co., Frick Building, Pittsburgh, Pa. Proposed by D. M. Howe.

Bogert, Wm. J., General Agent, San Pedros, Los Angeles & Salt Lake R. R., Oliver Building, Pittsburgh, Pa. Proposed by D. C. Noble.

Bottomly, E. S., Chief Joint Inspector, B. & O., P. & R. and C. V. Rys., Martinsburg, W. Va. Proposed by E. J. Leonard.

Drake, Thos. E., Clerk, Superintendent's Office, B. & O. R. R., 4631 Chatsworth Ave., Pittsburgh, Pa. Proposed by W. C. Drake.

Foggin, Geo. T., Foreman, H. K. Porter Co., 15 Dilworth St., Pittsburgh, Pa. Proposed by B. L. Tamkins.

Frame, R. S., Jr., Assistant on Engineer Corps, P. C. C. & St. L. Ry., 12 Dewey Ave., Ingram, Pa. Proposed by H. Edgar Boyle.

Franey, J. F., M. P. Inspector, B. & O. R. R., Pittsburgh, Pa. Proposed by S. A. Cromwell.

Hagerty, E. D., Assistant Storekeeper, P. R. R. Co., Twenty-eighth St. Shops, Pittsburgh, Pa. Proposed by Charles McGaughey.

Hawthorne, F. M., Assistant on Engineer Corps, P. C. C. & St. L. Ry., 88 Emily St., Crafton, Pa. Proposed by Harry Edgar Boyle.

Hill, G. W., Signal Supervisor, P. C. C. & St. L. Ry., 28 Haldane Ave., Crafton, Pa. Proposed by H. Edgar Boyle.

Holt, Thos. W., Storekeeper, Pressed Steel Car Co., McKees Rocks, Pa. Proposed by G. C. Baldwin.

Jack, C. H., Clerk, Superintendent's Office, B. & O. R. R. Co., 413 Chestnut St., Versailles, Pa. Proposed by W. C. Drake.

Johnson, Carl A., General Foreman, American Spiral Spring & Mfg. Co., Fifty-sixth St. and A. V. Ry., Pittsburgh, Pa. Proposed by John Pfeil.

Jones, W. A., Asst. Engine House Foreman, Penna. Lines West, 286 Jefferson St., Rochester, Pa. Proposed by E. A. Knight.

Koelbel, Chas. H., Master Mechanic, Monarch Steel Casting Co., 347 Grand Boulevard, W., Detroit, Mich. Proposed by C. W. Alleman.

Law, F. H., Commercial Agent, Illinois Central R. R., 907 Oliver Bldg., Pittsburgh, Pa. Proposed by A. G. Mitchell.

Milliron, E. L., Manager, Pittsburgh Branch, S. F. Bowser Co., Oliver Bldg., Pittsburgh, Pa. Proposed by D. M. Hauger.

McDaniel, Chas. W., Rep., Fiske Bros. Refining Co., 701 Empire Bldg., Pittsburgh, Pa. Proposed by D. J. Redding.

Orbin, Geo. N., Engineman, B. & O. R. R., 4841 Lytle St., Pittsburgh, Pa. Proposed by A. F. Coulter.

Osmund, C. M., Shipping Clerk, American Spiral Spring & Mfg. Co., 5604 Camelia St., Pittsburgh, Pa. Proposed by W. W. Shields.

Pfeil, George, Asst. General Foreman, American Spiral Spring & Mfg. Co., Fifty-sixth St. and A. V. Ry., Pittsburgh, Pa. Proposed by W. W. Shields.

Rees, Harry S., Chief Clerk, Per Diem and Mileage Dept., Penna. Co., 7028 Frankstown Ave., Pittsburgh, Pa. Proposed by A. H. McNaight.

Rogers, R. E., Treasurer, Jas. B. Sipe Co., Drawer 550, N. S., Pittsburgh, Pa. Proposed by W. L. Ferguson.

Shumaker, Fred S., Foreman, Penna. Co., Beaver, Pa. Proposed by E. M. Mensch.

Simpson, T. H., President, Michigan Malleable Iron Co., Detroit, Mich. Proposed by C. W. Alleman.

Swingly, G. D., Division Engineer, B. & O. R. R., 5705 Jackson St., Pittsburgh, Pa. Proposed by J. J. Publow.

Thurlby, A. R., Road Foreman of Engines, P. & L. E. R. R., McKees Rocks, Pa. Proposed by R. M. Long.

Toomey, J. J., Rep., Ball Chemical Co., Fulton Bldg., Pittsburgh, Pa. Proposed by H. G. Taylor.

Townsend, Frank M., General Agent, Colorado Midland Ry., 829 Oliver Bldg., Pittsburgh, Pa. Proposed by George N. Riley.

PRESIDENT: As soon as these applications have been favorably passed upon by the Executive Committee the gentlemen will become members.

Is there any further business to come before the meeting? If not, we will proceed with the paper of the evening, by Mr. F. N. Speller, of the National Tube Company; the subject is "The Development of Locomotive Tubes and Their Treatment."

"THE DEVELOPMENT OF LOCOMOTIVE TUBES AND THEIR TREATMENT."

BY MR. F. N. SPELLER, METALLURGICAL ENGINEER, NATIONAL TUBE CO., PITTSBURGH.

The manufacture of charcoal iron railway boiler tubes was described by Mr. Geo. G. Crawford in a paper on that subject read before the Western Railway Club, January 1904. Some of the views shown here tonight are taken from this paper and represent the old process by which charcoal iron tubes were made by the National Tube Company until about two years ago. These processes are now rarely, if ever, used and have become largely a matter of metallurgical history.

The tube industry owes much to the railroads for its development; in fact, the invention of lap welding may be traced to the necessity, which arose on the building of George Stevenson's first locomotive, for a tube which would be safer and stronger than the butt welded tube, the only one made at that time. Since Steven-

Refinery. Formerly used in first stage of manufacture of charcoal iron.

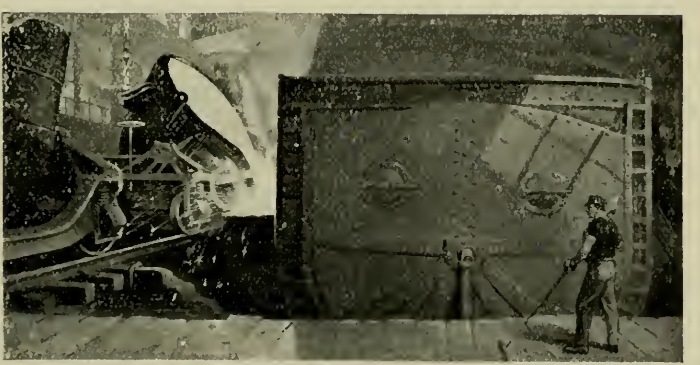
Forge in which the partially refined metal was reduced to form of a bloom, which was then hammered and rolled into a bar.

son's day the manufacture of locomotive tubes has increased in quantity and quality as the demands of railroad service became more exacting, and the whole tubular industry was no doubt favorably affected thereby. Seamless cold drawn steel tubes were introduced about the year 1886 and established a new standard of strength, ductility and endurance under many conditions of service. Later on a satisfactory grade of soft steel was produced which could be lap welded like charcoal iron, and this also has been much improved, so that we now have practically three classes of tubes for locomotive service—charcoal iron (lap-welded), steel (lap-welded), and seamless steel. Charcoal iron formerly was made from a special grade of pig iron, made in a small blast furnace using a charcoal fuel. The product of this furnace was charged into the refinery, where about one-half of the impurities were oxidized and fluxed away, the metal being afterwards further refined in lots of 300 pounds or so in a slightly modified type of the old catalan forge with charcoal as fuel. The use of so much charcoal has necessarily been stopped, and in many other respects the manufacture of charcoal iron for tubes has of late years been considerably modified. Of these changes we are not in a position to speak, for, as it was evidently impossible, for obvious reasons, to continue the manufacture of charcoal iron strictly along the old lines, we abandoned the making of charcoal iron tubes about two years ago in favor of lap welded and seamless steel, which had by that time been proved a fit substitute, and in some respects, decidedly superior to the older material.

You all understand, of course, that when we speak of steel in this paper it refers more to the method of manufacture than to the finished product, as the steel used in the manufacture of tubes, as a matter of fact, is a purer form of iron than that made by the charcoal process, and, like the older metal, cannot be tempered.

A special grade of Bessemer steel was at first used in the manufacture of lap welded tubes, on account of its superior welding quality, but later on had to be abandoned, as under some conditions it was found to develop brittleness in the beads after the tubes had been in service some time. The substitution of basic open hearth steel low in carbon and with less than .05% phosphorus and sulphur has been found, after more than two years'

Running Pig Iron Into Ladles.



Pouring Pig Iron Into Mixer.

trial, to entirely do away with any tendency of this kind, and, as now made, there is little difficulty in securing a strong weld with this steel.

Seamless and lap welded steel tubes are now made from practically the same grade of soft basic open hearth steel; the process of manufacture of lap welded tubes will be illustrated and described in the photographs which follow. Your visit to the seamless mill this afternoon has given you a fairly good idea of that process, especially as applied to the new hot-finished tube.

It is a good thing for manufacturers and consumers to get together, as we are doing this evening, and learn each others' troubles. Perhaps out of the discussion to which we are leading up something of value to both sides will result. Let us, then, take up what seem to us to be the main points requiring attention in the locomotive tube in order that it may give the best service under modern conditions:

First. *Resistance to Corrosion.*—The manufacturer should furnish a tube in the best possible condition to withstand corrosion and pitting, that is, the metal should be as uniform in composition and density as it is possible to make it. Much can be done to lessen the tendency to pitting by proper attention to the making of steel and the way it is worked.

We have been experimenting on this problem now for several years, and have gone to considerable trouble in the matter of testing and inspection of material and in the process used for manipulating the steel, so as to produce a tube which will resist corrosion as well as iron can be made to do so; and, judging from the reports of comparative service tests which have been received, steel so made is, in this respect at least, the equal of the best charcoal iron.

After all, however, the solution of this problem is largely in the hands of the user. Iron or steel will corrode, in spite of anything that can be done, if certain material is in solution in the water, particularly dissolved oxygen or carbonic acid. By the removal of these harmful agencies corrosion may be reduced to practically nothing. It is generally understood nowadays that water conditions have everything to do with corrosion, and the simplest solution of the problem is to treat the water with the ob-

O. H. Furnaces in which iron is refined to steel of composition found best adapted for the manufacture of tubes.

Teeming Steel Into Moulds.

ject of making it as harmless as possible. The development of the modern tube to withstand corrosion and the treatment of water have together practically eliminated this trouble, so that it is rarely the case that tubes fail nowadays through pitting.

Second. *Leaking in the Flue Sheet.*—The construction and handling of the engine has so much to do with the trouble experienced from leaky flues that it is difficult to determine how much, if any, of the responsibility for this should be placed on the tube material. If railroad engineers will tell us what qualities are required in the tube to make it hold tight in the flue sheet, we will be glad to follow their suggestions as closely as possible. At the present time the steel tube is made as stiff as possible, consistent with the best welding quality and ability to stand up successfully under expansion and beading in the tube sheet.

Third. *Strength and Ductility of Material.*—The tube should be of such quality as to stand repeated tightening in the flue sheet without cracking or showing undue evidence of fatigue, nor should these weaknesses develop during the life of the flue in service. The material found best adapted to give these properties is a special grade of soft open hearth steel carrying not over .05% phosphorus or sulphur.

Fourth. *Weldability.* The quality of the metal and method of handling are equally important in safe ending. Soft steel has been found somewhat harder to weld than charcoal iron,* but it has been greatly improved in this respect. The necessity for a good welding quality steel is of first consideration in making locomotive tubes so that they may be easily safe ended, and this point has received a great deal of study, especially in the manufacture of lap welded tubes, where it is, of course, one of the first essentials to manufacture. Charcoal iron carries considerably more impurities than soft open hearth steel, and these impurities form a self-fluxing mixture which facilitates welding. Railroad specifications have been so tightly drawn on composition, in some cases, as to work against the production of a good quality of steel for locomotive boiler tubes by calling for unnecessarily low phosphorus and sulphur. There is now very good reason to think that a mistake has been made in this direction, and that the general

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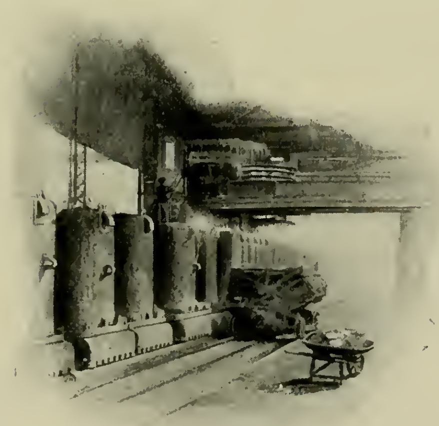
*This refers to genuine charcoal iron as formerly made without the use of miscellaneous steel scrap.

Stripping Ingots.

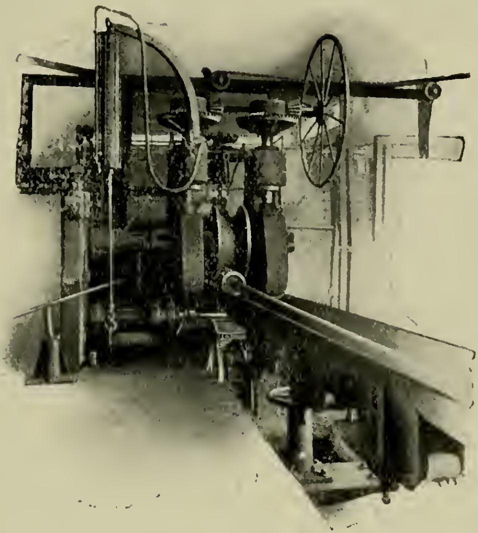


Running Steel Into Mold.

welding quality of the steel would be much improved, and the steel at the same time would lose nothing in other respects, if the maximum phosphorus and sulphur limits were both raised to .05%. With producer gas, now generally used of necessity, it is a very difficult matter to keep the average sulphur in the heat below .035%. The sulphur in any tube might be .04 where the ladle test shows .035%, and in order to remove this sulphur in the open-hearth furnace the steel has to be held and worked in such a way as to frequently leave it dry and difficult to weld.

Before the steel can be welded in practice a fluid cinder must be formed on the surfaces which are to be united. If the metal is heated too far above the point at which the cinder should flow, it will be burned and destroyed. We endeavor to have the range of temperature between the cinder-forming and burning points in the steel as wide as possible, so as to assist in lap welding and give the largest margin of safety in safe ending. Considering the variety of the requirements it seems to us that the composition of the metal should be left largely to the discretion of the manufacturer, so far as is consistent with a certain specified standard of physical quality in the finished tube. We frequently go to the trouble of rephosphorizing for the purpose of improving the fluxing and welding quality of our steel.

The method of safe ending, we have said, has as much to do with obtaining satisfactory results as the material, but we will not attempt to lay down specific rules as to construction of the furnace and heating, for many of the practical shop men present who are welding flues every day are much more able to discuss this side of the problem. However, there are a few broad principles on the heat treatment of tube steel which should be taken into consideration. The preliminary heating of the body tube, preparatory to flaring out the end, should be carried to a bright orange color, judging by good shop light, 1750° F. In the case of steel on steel, if the body tube is allowed to cool black after heating to this temperature and inserting the safe end, the grain structure will be refined and the metal put in much better condition for the welding operation which follows. Moreover, if the pre-heated body tube is returned to the furnace without cooling, the metal may be crystallized or burned before the safe end has been heated hot enough to weld. Should there be any considerable difference in thick-



Welding Rolls. Mandrel in Position.

Finishing side of welding furnaces in N. T. Co. Mill, McKeesport, showing cooling tables in detail.

ness between the safe end and body tube, it is evident that there is again a risk of overheating the one before the other is sufficiently heated to weld. If the body tube is returned to the furnace while red hot and the safe end is at the same time a gauge or two heavier, there is, of course, all the more chance of crystallizing or burning the body tube at or near the weld. Taking unnecessary risks of this kind often explains subsequent failures, which should not be charged up to the flue maker.

It is not unusual for a flue welder who has never handled steel to have trouble for a few days. Remembering the above points, and using his experience to the best advantage as to the condition of his furnace, the character of the flame, temperature, etc., the average man will soon be able to do equally reliable work with steel as with charcoal iron, as the experience of welders all over the country will show.

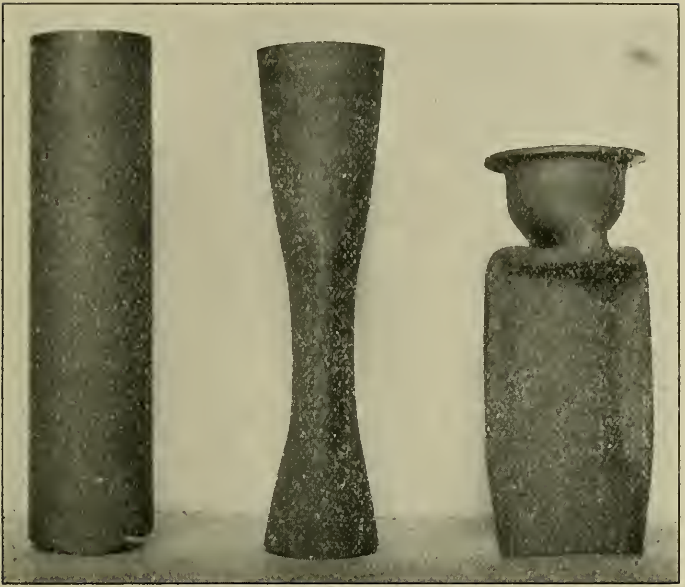
Fifth. *Uniformity of Material.*—This is a quality which the tube should have in a high degree, both as to physical and chemical properties. There is no difficulty as to the average steel tube nowadays standing the Master Mechanics' tests, made on one sample out of each hundred tubes. We have, however, recently designed a machine to make the flange, crushing-down and flattening tests on each end of every tube. This gives assurance both as to the character of the metal in each individual tube and also, in the case of lap welded tubes, as to the welding quality being satisfactory. Steel tubes are now made in one grade of material suitable for either body tube or safe-ending.

Having briefly considered the subject from the standpoint of the manufacturer who is striving to produce the best tube that can be made for locomotive purposes, we will be glad to get the benefit of the experience of practical railroad men who have been following up this matter, to whom we must look for the final word on the locomotive tube question.

(A complete set of lantern slides were exhibited showing the process of manufacture of lap welded steel tubes.)

PRESIDENT: Gentlemen, the paper is now open for discussion by visitors as well as members of the Club.

MR. D. J. REDDING: Mr. Chairman, Mr. Speller spoke of the necessity of allowing the tubes to cool down somewhat after



Special Boiler Tube Test.

Crop end on left; same after crushing laterally and the last operation in which a flange is turned and the tube crushed down vertically. This test is made on the crop end cut from each end of every tube in a machine specially designed for this purpose.

Group of Pittsburgh Railway Club, Ellwood City Plant, April 28, 1911.

expanding them before welding in the safe ends. Now, we do not do that in our practice. We bring up the welding heat in one operation, stick the safe end in as the heat comes up, and without cooling any, we proceed to get the welding heat and weld the safe end. We have had very few failures under that process. I would like to have Mr. Speller say what his experience is as to whether he has found a large percentage of failures of ends on account of not letting the tube cool before proceeding with the weld.

He spoke of the fact that they tried to keep the sulphur down to .03%, and found that in old safe ends, which have been removed after having been in service for some time, the sulphur was as high as .06%. I would rather think that indicated that it is advisable to keep the sulphur down, because if sulphur is added in service, from fuel burning up against the tube, if he is not so particular to keep the sulphur down in the beginning the percentage which was found in the tubes removed would be reached earlier in the life of the tube. It would seem to me that it would be better to start with a low percentage and have something to work on before the tube got in such a crystalline condition that it would break in working over.

The tests shown in one of the samples which Mr. Speller says were made on the crop ends of each tube rolled, show considerable more reduction in the center and very large upsetting reduction. I would like to know whether they were made hot or cold. The Master Mechanics' specifications call for the upsets to be made cold.

MR. SPELLER: Perhaps Mr. Redding misunderstood what I intended to say in regard to the cooling down of the body tube ends, after expansion before welding. I did not mean that it was necessary, but rather desirable to do so in cases where trouble is experienced in burning of the body tubes through overheating. A man who has had some experience in welding steel will not get into this trouble, but it is one of those things where unnecessary risks are often taken. It is just as well to remember that crystallization may be caused in this manner, so that when you find a tube breaks off near the weld, it is probably caused by overheating at that point in safe ending.

As to the matter of sulphur, we do not object to a reasonably low specification, but we have yet to learn what advantage is gained, and, as I tried to point out tonight, in getting the sulphur down to .035% there is danger of injuring the steel in other respects, that is, in making it dry and difficult to weld. It seems more advantageous to be satisfied with .05% sulphur and have the steel in better condition for welding, especially as after the tube has been in use for some time it absorbs sulphur to a certain extent, anyway.

The crop ends which we test in the flanging machine are all worked cold. They are cut off and immediately crushed down and flanged, and the tube rejected or passed according to the results.

MR. REDDING: Are those welds which you spoke of, which break off sometimes, made with a long scarf, or are they the same as we make them, practically a butt end? If you make a scarf $\frac{5}{8}''$ long the edge of your tube is very thin and you are liable to burn it, but, as we weld the tube, we make a short scarf, not over $\frac{1}{4}''$, practically a butt weld.

MR. SPELLER: The case I have in mind was where the tube was burned back of the weld on the body tube rather than on the weld. I do not remember what the scarf was at this time, but the burn was away from the weld, usually on the body tube.

PRESIDENT: We have with us Dr. Angus Sinclair, whom we all know by reputation, and we hope he will have something to say on this subject.

DR. ANGUS SINCLAIR: Mr. President and gentlemen, leaky tubes have been the bane of locomotive operation since I can remember—and I can remember pretty well back. And I was there when the small locomotives, which were the successors of the Rocket, came out with their 6′ long tubes, and I have seen it grow until the 22′ tube has come into service to some extent. And I do not remember any time when there was not trouble with leaky tubes. The railroad people blame the manufacturers and the manufacturers blame the railroad people. From my own experience with tubes I think gross carelessness in handling the engines themselves has been the cause of failures more than anything else. There is no doubt that inferior material has been used for tube purposes to some extent, bu I think the real difficulty has been in careless handling. That has been my experience, anyhow, as an engineman.

I remember when we used to have brass tubes. They had an idea that brass tubes would cause less trouble from leaks. In fact, we had nothing else in Scotland in my time. But there was always more or less trouble from the same source that we complain about, leaky tubes.

The man at the dumping pit is the fellow who causes most of the leaky tubes. One time I got charge of an engine that had a very bad reputation for leaky tubes and leaky firebox. I am something of a boiler-maker myself. I spent the first six months of my apprenticeship in the boiler shop; so I have always known a little about tubes and boiler work, more than the ordinary mechanic gets a chance to know. And when I got this engine I examined her fire-box very carefully, and I thought I would rather give up than take the engine. And I said so to the master mechanic. He said, "Well, we are very short of engines; you have a day run and they can work at your fire-box every night, so it is easier for you to run that engine than any others that we have, and you better try it." So I agreed to do it, and I began watching the engine very closely, and I found that if there was pumping going down hill or if there was a good deal of firing to do going down hill the tubes would be leaking by the time we were done the trip. So I sat down and watched my firing and made my fireman very careful in his firing, and the result was that I brought the engine in one night perfectly dry, of which I was proud, and she was leaking badly in the morning. Of course, I knew that leakage had been started in the ash pit. The next time I came in I went and saw the fire dumped, and I took some care of that myself. I told the man who was dumping the fire that he must close the dampers. That was a thing they never seemed to think of in this country, closing the dampers as soon as the fire was out to keep the cold air from rushing through. I kept that up a while, watching every night, until they got in the way of attending to it as I wanted, and I ran that engine six months very satisfactorily. There was scarcely any leakage at all to complain of. That was just the effect of care; and the opposite is the cause of nearly all troubles. You can see the fire dumped in the pits and the engines put in very often with the blower on. It is beyond nature that the engine should keep from leaking.

However, I think there is a tendency manifest in later years to rectify that, and those in charge of the running of engines are paying attention more to see that the engines get a chance at the end of the journey. If that was closely adhered to I think there would be great improvement in the durability of the tubes and the freedom from trouble. The manufacturer says the master mechanic is to blame for most of the troubles and the master mechanic says the manufacturer is to blame for not giving good material. But I think it would be a good thing if both sides would get together a little more and know and reason about what the matter is and what the material is that is in the tubes. When a set of tubes fail, let them examine them carefully and closely and meet together about it, and I think that would have a very good effect. There is no use in one side blaming the other and let it go at that. It should be "Let us reason together," and I think that is the real remedy for the tube question.

MR. REDDING: There is just one unfortunate thing in connection with that. In this latter day service fire-boxes are so big and the demands for steam are so great that we have got to open the ash pan wide. We have self-cleaning ash pans to comply with the requirements laid down by the Interstate Commerce Commission, and the ash pans do not have dampers. They are full of netting and the sides are left four or five inches down from the water bar, and after the fire is dumped and the engine started to the round-house, there is no reason in the world why all kinds of cold air can't get in against the flues. While it is unfortunate, that is one of the conditions that we are up against. We are compelled to carry that kind of ash pan and it cools the tubes down very quickly.

MR. F. H. STARK: Some few of us that had the privilege and pleasure of attending the Americus Club last night heard a very able address by ex-Senator Young, who paid his compliments to the politicians and reminded us that this is an age of return to the farm. He further commented on the action of our present Congress, and intimated a belief in some quarters that some of the Congressmen and Senators had better return to the farm. I felt a little bit that way myself. However, I am anxious to learn, and I would ask Mr. Speller to advise, whether it is a fair comparison in making tests between so-called pure iron, charcoal iron and open-hearth steel, by submitting the metal to acid tests? We frequently have samples submitted to us showing where open-hearth steel had been subjected to a few hours' test and reduced possibly 40% or 50%, and charcoal iron a little less, while so-called pure iron showed no depreciation whatever. If that is a fair test, which I doubt, it would indicate that we should return to the old wrought iron. We are building quite a good many power smoke-stacks and we are using different qualities of metal with a view to ascertaining later on which of the metals will resist corrosion. Possibly Mr. Speller can clear the matter up as to how to make a practical and fair test. We have something like sixty power plants, requiring a great many boiler tubes, and we are now using open-hearth steel. Our people consider that it is most economical, for the reason that when they specified wrought iron they paid for wrought iron, but received steel, so they concluded to buy steel.

However, we have ordered charcoal iron for safe ends, because I figure that we get a little better weld between the charcoal iron and the steel body that we do with steel safe ends. I would like to have Mr. Speller inform us on these points.

MR. SPELLER: I would not like to go into a discussion of corrosion at this time of night. However, a committee of the American Society for Testing Materials went into this question thoroughly, and you will find their report in the proceedings of that society for 1909 (report of Committee U on the corrosion of iron and steel, p. 209, last paragraph) to the effect that the test by acid is unreliable and misleading. The reason for this is that there is no comparison between solution and natural corrosion. Ingot iron which the speaker has referred to, which stands the acid test to advantage, is open hearth steel, highly refined, so that it is said to contain as much as 99.94% iron. So far the indications are that ordinary soft steel, if properly made, will stand up just as well under natural corrosion, but it will be some time before we have enough tests under service conditions to settle that point. However, such highly refined steel is much more sensitive to heat. We feel ourselves that the steel made for welding, which has been well worked, is as good as anything we know of at present, and have pretty good ground for this opinion, based on service tests. The method of making some of these tests was to place a set of tubes made up of two materials in the same engine; a duplicate set would be placed in another engine, reversing the position of the tubes. Sometimes railroad men prefer to take several engines of the same class and put different sets of tubes in each for trial. We have had tests on at least twenty railroads in this country and the results indicate little difference between modern steel, as made for welded tubes, and charcoal iron. This is about as much as there is time to say tonight on this matter.

PRESIDENT: We have with us Mr. Luther D. Lovekin, of the New York Shipbuilding Co. We would like to hear from him.

MR. LUTHER D. LOVEKIN: Gentlemen, I do not know that I can say very much about tube-making, because I had my first introduction into the matter today. But I might say that about ten years ago I had my first experience in using cold drawn tubing made by the Shelby Steel Tube Co., and I was very reluctant about undertaking it, because I had always heard that the old charcoal iron would stand so much better than steel, and the ship builders in general had heard the same thing. I made tests on the seamless cold, drawn tubes and from my examination I concluded that the steel tube looked pretty good and was worth a trial. I can now state that those steamers which we fitted with these tubes and which were for the American-Hawaiian Steamship Company, have been running both under coal and oil fuel for about ten years and they have had no difficulty at all with the Shelby cold rolled steel tube. Since then they have built about twenty ships and all of them have the same tubes.

I do not think it is fair to compare a steamship with a locomotive at all. From what I understand, locomotive engineers are compelled to renew tubes sometimes in six months or a year. We have no such difficulties as that in our steamship work. Our tubes will last for years. In fact, I have never known a set of tubes to be renewed in a year. I think this is largely accounted for by the fact that we do not alternately cool and heat our boilers like you do on a locomotive. Sometimes we will keep fire in the boilers continuously for a matter of sixty days, never having the fire out. Of course, that all helps. On these boilers I speak of we used them on coal for two years and after that converted the steamships to oil burners, and with this system no cold air whatever gets into the furnaces, because we used the closed ash pit heated air system, with forced draught; we never have an air temperature less than 250° or 300° entering the boilers.

I have been instrumental in engineering a great many of our naval vessels, and in discussing the question of steel and iron tubes there seems to be some doubt among the engineers that the steel tube is the equivalent of the wrought iron tube. We have had trouble with our power house and I began to blame it on the steel tubes, which rusted out in six years. We have put other pipes in, but we do not know whether they will last six years or more. The steel tubes evidently corroded, in my opinion, more from air than anything else. We found no chemical or electrical troubles. We have had new pipes in about four years, but we have not made an examination to see how they are.

My idea in coming here tonight was to find out something that has not as yet been mentioned. I understood Mr. Speller was going to tell us something about Spellerized steel tubes, and I have not heard a word about it. I assure you I am very much interested in knowing something about Spellerizing.

PRESIDENT: Will you tell us something about Spellerized tubes?

MR. SPELLER: That is another point that I do not want to get started on tonight, Mr. Lovekin; it applies to the lap-welded steel tube. Five or six years ago we began to study the question of corrosion in all its phases and found that the amount of forging and working steel received was one factor which had to do with its durability, so we got up a process to knobble, or knead, the steel while working it down to the plate, that has become known by the name referred to. It has a beneficial effect in making the steel more homogeneous and dense on the surface, but it is, of course, not by any means the only treatment having favorable results on resistance to corrosion; due care must be taken in making the steel. We find as result of service tests referred to before, that the lap welded steel tube so made will stand up better, or, at least, as good as the best charcoal iron.

PRESIDENT: Dr. Unger, may we hear from you on this question?

DR. J. S. UNGER: Mr. President and gentlemen, I was very much interested in Mr. Speller's remarks. The subject he spoke about is one that presents a good many phases to the user.

One point seems to have been impressed upon my mind, and that is, how easy it is for the user to unknowingly injure material that is initially good. To illustrate the point, I will tell you this story: A noted German investigator was called in to find the cause of the trouble a manufacturer was having in welding some tubes into the end of a thick plate, very similar to the head of a boiler, but much thicker. He found that after the weld had been made the plate began to corrode very rapidly, about 6″ or 8″ from the end of the tube, extending in a circular form around the tube. The portion of the plate near where the tube was welded, and that portion from 10″ to 12″ from the tube, was free from corrosion. He made numerous experiments and found that when iron or soft steel was heated to what we call a blue heat, approximately that temperature at which lead would barely melt, and then suddenly quenched, it corroded very much more quickly in that condition than if it had been quenched from a higher or a lower temperature. You can very readily see that you might easily get conditions of just about that description in welding on an end, and water might happen to fall accidentally, or a portion of the tube be quenched at just that temperature, with the result that corrosion at that particular point would be very much more rapid than at any other point on the tube.

Another thing for us to consider is this: We know that our water supplies are becoming very much more impure. A few years ago the Monongahela River was as pure as the Allegheny, but on account of the coal development and other causes, the water has become very much more impure. It frequently happens in our dry months that we have in the Monongahela River as much as 70 parts of free sulphuric acid per 1,000,000 of water. This means that a plant using this water for steam purposes requires a great deal of a salt which will precipitate the lime, magnesia and other injurious compounds and neutralize the free acid in the water. While these precipitants are diluted in the water, they remain in the boiler. As the water is lost by evaporation, the salts are concentrated, unless special means be taken for their frequent removal, until we are trying to make steam from what one might call an almost saturated solution. This means hard service for the tube.

The conditions that exist where we have high temperature and pressure in a boiler are not at all the same as those under ordinary atmospheric conditions.

We use the term corrosion in too general a sense. When iron or steel has deteriorated, or has been destroyed at temperatures less than a visible color, we say the material has been corroded, regardless of the cause of the destruction. Iron may be destroyed by erosion, oxidation at atmospheric temperatures, oxidation at temperatures below visible color, solution in a solvent, aided or unaided by the electric current, and by other causes. A remedy for the prevention of corrosion from one of the causes might accelerate corrosion from another. The acid test for corrosion merely shows the solubility of iron or steel in a dilute acid, and is an index of its solubility in the chemical agent. Tests have been made which indicate that this test is unreliable as an index of the resistance to corrosion under ordinary atmospheric conditions.

The question of corrosion is a very broad one, and without desiring to precipitate a discussion for which we do not have time this evening, I will say that I think the only test for corrosion is a test under service conditions.

MR. P. J. CONRATH: Mr. President and gentlemen, this discussion is now, and has been the biggest part of the evening, on corrosion, and I wish to continue a little further. Being a practical boiler-maker, at which business I have served the biggest part of my life, mostly on the railroad, I also have been connected in other positions on the different roads as general foreman and master mechanic. The boiler and the tube question is something that I have given a great deal of study to.

Going back to the subject of corrosion, this is not only due, at least that has been my experience, to impurities and the different formations in the water used; it is also due to a great extent to poor circulation and low temperature. It has been my experience that in our modern locomotive, with tubes 20 to 21′ 6″ long, that the tubes corrode mostly from the front tube sheet back say about four feet. This naturally led me to look into the matter, and study it more closely, to find why the tubes would not pit uniformly. My conclusion was that the circulation being poor at the front end of the boiler, and the temperature lower, caused the tube to pit greater there than elsewhere.

There are undoubtedly a number of experienced men here to-night who will agree with me that dissolved oxygen and gases at a low temperature will attack the iron or steel to a greater extent than where the temperature is higher and the circulation better.

Comparing iron and steel tubes, I have seen a number of comparative tests made on the different railroads in the past two years, where steel was placed alongside of iron to ascertain which would resist corrosion to the greatest extent. One particular case I wish to mention was where an engine had run 101,000 miles, and upon the removal of the tubes we found there were 46 iron against 14 steel that were pitted to such an extent as to make it necessary to consign them to the scrap pile.

I also followed up other engines, three in particular, all three of which had made a mileage of 62,000 miles, when the engine was shopped for general repairs. Each of these three engines had tubes on both sides with slight pitting, but there was scarcely any difference visible between them, the iron having withstood or resisted the corrosion equally as well as the steel.

To prove to you that it is not always bad water which causes tubes to corrode, I wish to relate to you an instance of where the most pure water practically would eat up the tubes and body of the shell in a few months. I am referring to some condensors built and used by a firm I was foreman for, about 15 years ago. In this case, the steam being condensed, the water certainly was of the purest, and yet after six or seven months' service, the tubes and bottom part of the shell were practically eaten up. All of our tubes used in these condensors at that time were charcoal iron. We experimented with different kinds of material for tubes, and finally installed brass, which resisted corrosion very well, but the bottom of the condenser would in a few months have holes eaten through it. We finally came to the conclusion that it was due to poor circulation and the low temperature in the bottom of the condenser, as the corroding and pitting greatly lessened after you left the center line going toward the top of the condenser, and tubes and shell of the condenser were intact at the top end. In order to overcome this trouble, we inserted a live steam line into the bottom of the condenser to force better circulation and a higher degree of heat. This was a great improvement and practically eliminated the trouble. I am mentioning this to show that it is not only the impurities which form in the water, but poor circulation and low temperature that cause corroding and pitting.

Taking up the question of leaky tubes, this is a far-reaching subject, and, I might say, inexhaustible. The International Boiler Makers' Association have taken up this matter from year to year in their conventions, and we have tried to solve the problem, and have in some cases made recommendations which I found to be a big improvement. This is by enlarging the bridges in the back tube sheet. It seems that the builders, in order to get plenty of heating surface, have crowded in too many tubes into the boiler, making the bridges or spaces between the tubes too small. It is reasonable that, especially in alkali water, the water has a tendency to pull away from the hot sheets; in fact, I have seen this demonstrated in a glass shell, with the tubes spaced very close together. Then by the use of a pan filled with asbestos and saturated with alcohol being used as a heater, the glass shell would allow you to see the circulation of the water, and it was surprising to see how the water, when the heat got to be very intense, would pull away from the sheet momentarily. This, of course, had a tendency to heat up the sheet and loosen the tubes in the back tube sheet.

On one of our Southwestern railroads, where I was last employed, the bridges on all of the smaller locomotives were increased from ½ to 13-16", and on the larger locomotives to 1 1-16". This, of course, increased the water space, gave better circulation and less tube trouble, and on a number of the large Pacific type engines, which carried 2¼" tubes, we welded a 2" piece 8" long on to the 2¼" tube when back sheets were renewed. This gave a greater body of water at the back tube sheet, close to the fire, and we found it was a big improvement over the old narrow bridges.

I do not care to take up a great deal more of your time tonight. There are a great many other experienced men here who probably wish to speak on this subject, but I wish to mention a few more existing evils which cause a number of engine failures charged to the tubes. One of these is irregular pumping of engine on the road, pumping of engine going down grade with the blower on, for example, an engine leaving the terminal with its time card rating of tonnage or probably a little more, having some heavy grades to climb, all preparations are being made by the engine crew to make these grades. The fire is being prepared, boiler is pumped full of water, and when they strike the foot of the hill, injector is shut off, engine being down in the corner working very hard. The fire in the fire-box at white heat, and as we climb the grade the water is gradually going down. By the time the top of the grade is reached, probably the water has almost disappeared, and as soon as the engine pulls over the hill, on goes the injector, and sometimes both of them, for fear that one would not supply the water fast enough, and you, as practical men, certainly know the consequence. The cold water rushing to the bottom, causes sudden contraction of the bottom tubes, and will loosen them, and before you are half-way down the hill you have the tubes leaking badly.

Another evil is engines being allowed to come over the cinder pit with probably one gauge of water. The fire cleaners and cinder pit men find the fire badly clinkered, and a half-hour or more is spent trying to draw the clinkers out of the fire-box, and before the fire is cleaned, they find that the water is disappearing, and it is necessary to put on the injector. All of this time the blower is also used in order to carry away the gases, and just as sure as the water is put into the boiler at this stage so sure will the tubes leak. The engine standing still, the water will not circulate, all of the cold water will rush to the bottom, cold air going through the bottom of the tubes at the same time, causing such sudden contraction that tubes are bound to become loose.

I thank you for your attention, gentlemen.

MR. M. A. KINNEY: I rather suspected that we might have some remarks this evening on the advantages of the iron tube, which we all know is in general use. Coming from a line which is, perhaps, the pioneer in the exclusive use of the steel tube (the Hocking Valley) I necessarily will have to speak on the affirmative, as all my predecessors have apparently been doing here tonight. We have been using the steel tube about twelve years in districts that have bad water and our use has, of course, developed some points in the care of it that may be of interest to you gentlemen present.

Speaking first of the welding of the steel tube, we use steel safe ends entirely. This is with the seamless tube. In preparing a tube for the welding of the safe end, we do not depend on the expander, but ream it. This gives us a bright surface. We also scarf the safe ends with dies. At present we are buying safe ends in condition to weld, having two bright surfaces to come together for welding. There is no question as to a successful operation. Tubes are tested with hydraulic pressure of about 300 pounds after leaving the welding machine, and rarely, if ever, is there a case where we develop a leak at the new weld. After the flues are placed in the boiler, an operator works them with pneumatic hammer. Occasionally we will open an old weld, but we have run along twenty engines on which not one leak will develop when the final test is applied.

It does not matter what kind of a tube you buy, if you do not give it the proper care—iron or steel. Your success in the development of the steel tube will be the care you give it in the application of same to the boiler and the care it receives from the boiler maker in the roundhouse.

In applying our tubes we use the Prosser expanders, using the roll very lightly, and in the engine house we have thrown away the rolls entirely. We allow no boilermaker in the roundhouse to have a roll in his possession.

The beads of a steel flue hold up well, and I am satisfied that we have far less trouble from wearing out or breaking off of beads on the steel tube than we would have on any iron tube on the market today. I have had experience on other lines which I feel warrants this statement.

We are all familiar, as a gentleman has just spoken, with the care of tubes and the care of boilers and fire-boxes coming to and leaving our terminals. There cannot be too much said on this subject. I want to say that no one who is giving the steel tube proper care is making a mistake in using the same as a general proposition.

MR. HENRY GILG: Mr. President, I would like to ask a question: On my last trip a superintendent of motive power of a large railroad system told me that they had reduced their boiler troubles to a minimum by carrying 10 per cent below the pressure allowed. That is, they were allowed 200 pounds and they were carrying only 180. Why would it not be well to extend that practice to the roads that are having considerable difficulty?

PRESIDENT: Mr. Redding, will you answer that?

MR. REDDING: We need every ounce of power that we can get. We are increasing the cylinder and boiler capacity, and we cannot get along with any less pressure than the engine is designed for.

I want to corroborate what was said about the steel tube. We have tried both iron and steel, and we have no trouble with steel safe ends and steel tubes. They stand up better in service and stand a great deal more punishment. On engines which do not receive very severe treatment, such as switching engines, we frequently have tubes that last too long. The different State laws now in effect require their renewal every three years and we have quite a number that we have to remove to make the inspction, not because the tubes are worn out, but because the time is up. Tubes that get punishment over the road of course wear out faster.

MR. LOVEKIN: I have been designing boilers for about 15 years and this is the first opportunity I have really had to ask a crowd of expert gentlemen what use the copper ferrule is at the end of a tube, the way in which the locomotive engineers apply it? We have never done such a thing. I have never been able to get a reply to my question. Possibly some of you can tell me what use a copper ring is between a steel tube and a tube shell. I have conducted thousands of tests in expanding and have secured wonderful results in expanding tubes into grooved or recessed tube sheets, and the only reason I can figure out any advantage when using copper ferrules is that on account of the copper being of a softer material it fills the crevices that exist in the tube plate or the tube and, therefore, make a more perfect union. Last summer, while I was abroad, I visited the Babcox & Wilcox Co., in Scotland, and noticed they had a very excellent way of putting tubes in water tube boilers. I spoke to the manager of the works about it, and he said it was due to the fact that there had been a great deal of trouble with poorly expanded tubes and in order to make the best possible work they ream out all of their holes and grind every tube, and allow about .005 to get a tube into a tube sheet. I asked him about the copper ferrules and he knew no more than I did. So I would like to be informed as to what value it really is.

PRESIDENT: Mr. Conrath, will you answer that question?

MR. CONRATH: Mr. President and gentlemen, the question asked is why we use a copper ferrule in the back tube sheet. The reason that a copper ferrule is used in the holes of the back tube sheet is that the copper is much softer and has a great deal more expansion than the iron, consequently, it being stationary in the hole, when it expands, it tightens around the tube, and, again, it forms a joint much easier between the tube and the tube sheet than it would if tubes were put in metal to metal. It is reasonable that working the tubes without a ferrule under them, you would have to work them to a greater extent in order to make a joint, and would crystallize the material much quicker than where you have the copper ferrule, so the reason is that the copper will expand to a greater extent, and the metal being softer will make a joint much easier between the tube and tube sheet.

I wish to relate an experience that I had some years ago, where a number of water station boilers had been ordered, and tubes were applied without the use of a copper ferrule. These boilers were in service scarcely three months when they began to give us trouble by tubes leaking, and it was practically impossible to keep the tubes tight, and therefore all of them had to be removed and copper ferrules applied and tubes reset.

Where the water is pure and soft, the tubes do not have to be worked after installation, or very seldom, it is not absolutely necessary to use the copper ferrule. I was at one time foreman in a shop in the city of Chicago, and found in the case of all the boilers that were built for home service where lake water was used, which is very pure, it was not necessary to apply a copper ferrule, as the tubes would run indefinitely without being worked. But in placing metal to metal, where tubes have got to be worked continually, it is obvious that material will crystallize much quicker than where it is cushioned by a copper ferrule.

I have always been an advocate of a heavy copper ferrule, say not less than 40 lbs., which is 1-16″ thick, and have always insisted on coppers being ordered by inside diameter, as a standard, say 1 7/8" for 2" tube, and increasing the thickness of the copper as the holes become large through continuous working, carrying in stock say about five different thicknesses, 40, 45, 50, 60 and a 70-lb. copper. The different thicknesses of the copper in the variation of holes will fill out, and you can maintain the same swage and flue tools for all 2" tubes. This does away with having a half-dozen different kind of swages for the same set of tubes, as it is very essential that tubes fit the holes at installation, and by this method a good, close fit is much easier obtained than by making the different-sized swages to suit the holes. It does not require as much work to set them to place as it does where the tube is considerably too small, and the life is worked out of the material in order to set it to its proper place.

I thank you, gentlemen, for your attention.

MR. STARK: I believe I voice the sentiment of every person here that we have had a very interesting and instructive discussion here tonight. I would, therefore, move you that we extend a vote of thanks to the National Tube Co., and especially Mr. George Riley, our genial host, Mr. J. F. Townsend, Mr. Speller and Mr. Nicholson and a score of their associates whom I do not know. This is the second occasion that we have been entertained by these people, together with our friend, Bihler, of the Carnegie Steel Co., and I am sure this day has been unique. It has been a day of good-fellowship, and this Club, above all clubs, stands first for sociability. I move you that we extend a hearty vote of thanks to these enterprising gentlemen.

The motion was seconded and carried by unanimous vote.

PRESIDENT: Mr. Riley, you and your associates will please accept the thanks of the Club thus extended to you.

MR. RILEY: I will call on my friend, Bihler, who is the orator of the Steel Corporation, to properly respond.

MR. L. C. BIHLER: We have listened to a great deal of serious talk, and one of the things impressed upon my mind is the number of people who have touched on "corrosion." Mr. Redding mentioned it, Mr. Sinclair, I think, touched on it, and Dr. Unger also spoke about corrosion; in fact, there has been so much talk tonight about corrosion, that the fact that every member who did get up to discuss and said he would "talk about a minute," and talked fifteen, then said he was not half through—impressed me that this subject of corrosion is big enough to discuss for an entire evening, so I would suggest that the President set aside an evening to thresh out this question of "corrosion." It is, undoubtedly, serious and important, because so many have touched upon it, and certainly it would make a good subject for an evening's discussion. I know a member who, I believe, would talk about three hours and a half on it, if you would let him and listen to him, and there are a few others who could add several hours to that.

I would like to modify Mr. Stark's motion to the extent of adding also the names of Mr. Edward Worcester and Mr. Taylor Allderdice, Vice Presidents of the National Tube Co., both of whom were with us on the trip and are equally deserving of mention. I was only to take five minutes; I have taken four and a half and I will let the other half go by default.

There being no further discussion,

ON MOTION, Adjourned, at 10:08 P. M.

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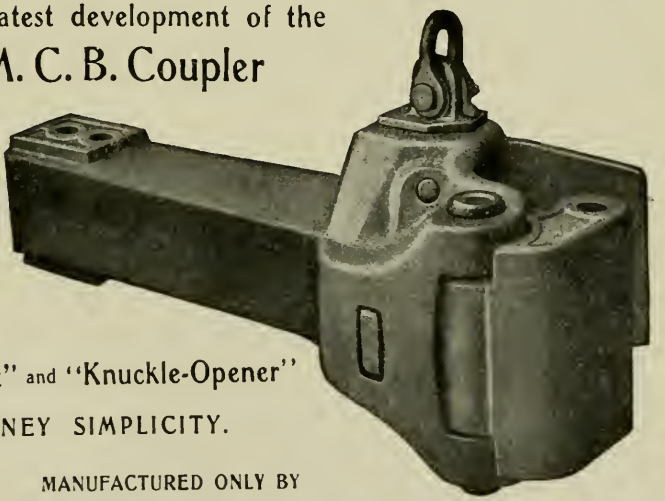

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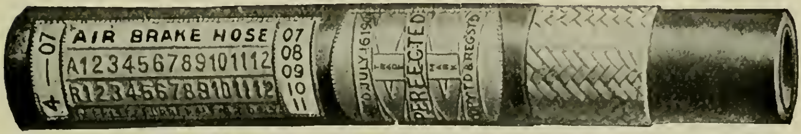

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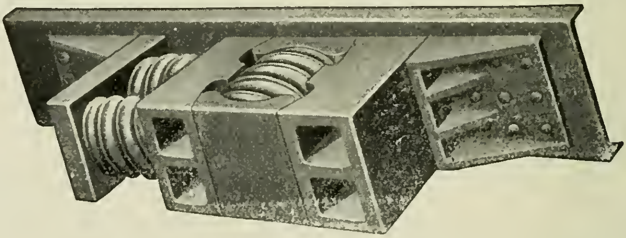

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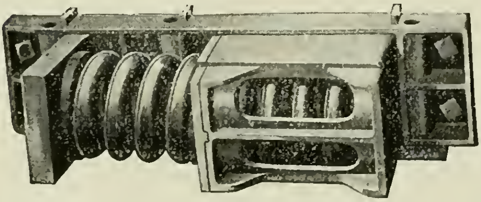

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Vol. X. May 26, 1911 No. 7.

"CHOOSING A LOCOMOTIVE."

By Mr. G. Greenough, Sales Manager, Baldwin Locomotive Works, Philadelphia, Pa.

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BOILER TUBE ECONOMY

*No. 2.

MAINTENANCE COST

¶ In the last issue of The Official Proceedings of the Railway Club of Pittsburgh an instance was cited of a considerable economy attained by using Steel Boiler Tubes where Iron Boiler Tubes had formerly been used.

¶ The experience was contained in the report of a foreman Boiler Maker of a large Railroad in the Middle West, and specific figures were given for five passenger and five freight locomotives.

¶ In every instance cited, steel flues showed considerably greater mileage than iron flues, and in one instance the mileage by steel flues was almost three times the mileage made by iron flues.

¶ The fact should be borne in mind that these figures are taken from the Official Proceedings of the International Master Boiler Makers' Association, which held their third annual Convention at the Hotel Seelbach, Louisville, Ky., April 27th to 29th, 1909.

¶ Attention is now called to a supplementary report made by the same person at the fourth annual Convention, held at the New Clifton Hotel, Niagara Falls, May 24th to 27th, 1910 (page 129), and appears in the Official Proceedings Report and reading as follows:

"I have a little report which I would like to read. I made quite an extensive report last year in favor of steel flues, I have a few figures here to verify my assertions to it was at that time. I will read this report to the convention.

"I have not a great deal to say on this subject at this time. You will remember that I submitted quite a lengthy report on this subject last year and I am pretty well exhausted with the exception of a few figures which I would like to submit to substantiate the argument I made last year in my report in favor of steel flues and safe ends.

"Since I made my last report to you before the Master Boiler Makers' Association I have gathered some data. I have one engine that has 2¼-inch by 21-foot tubes to submit to you as evidence at this time. This engine when first turned out of shop was equipped with iron tubes and safe ends making a flue mileage of 47,230 miles. These flues were then removed and the same flues were safe ended with steel safe end material. After these flues had been applied this engine made a flue mileage of 68,361 miles, this making a gain of 21,131 miles in favor of the steel safe ending.

"We have experienced no trouble to speak of on account of flues leaking since this engine was equipped with steel safe ends. We have also had a test made of 28 freight locomotives which were equipped with steel tubing and these engines made an average of 75,000 miles per engine.

"Our previous flue mileage in this particular location equipped with iron flues would not average over 50,000 miles per engine, this would make a gain of 25,000 miles in favor of the steel flues. We do not experience any trouble in welding the steel safe ending in the iron flue. We have also had a great deal less of flue leakage with steel than we do with iron. I do not know that I have anything more to say at this time. Hoping this information will be of some advantage to you, I remain."

¶ Now, many railroads (as well as plants using stationary boilers) have peculiar conditions—that is, there may be bad water, or other unusual circumstances.

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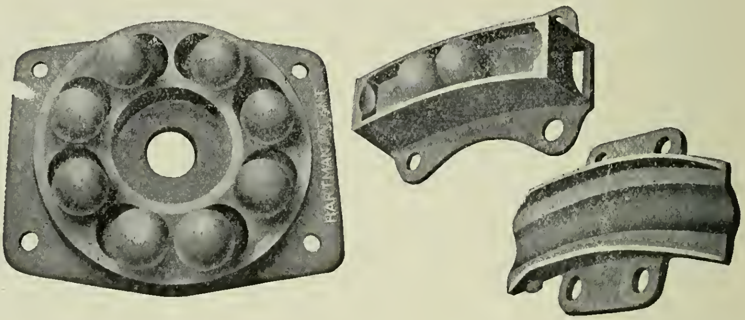

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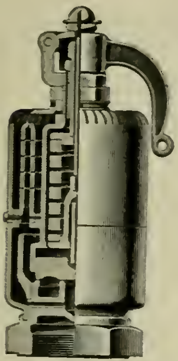

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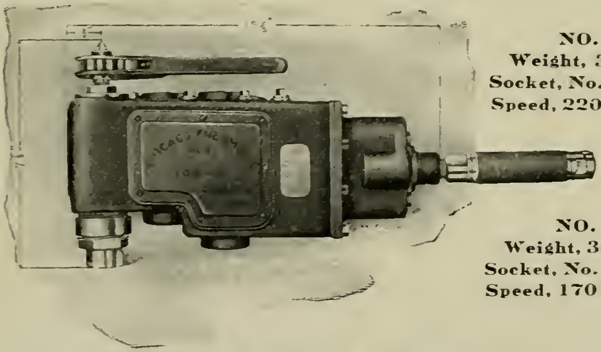

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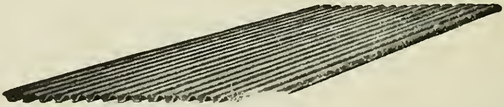

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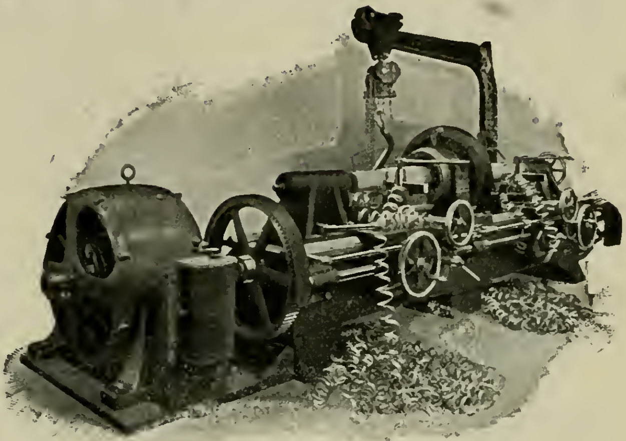

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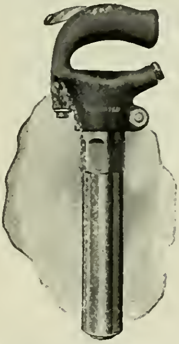

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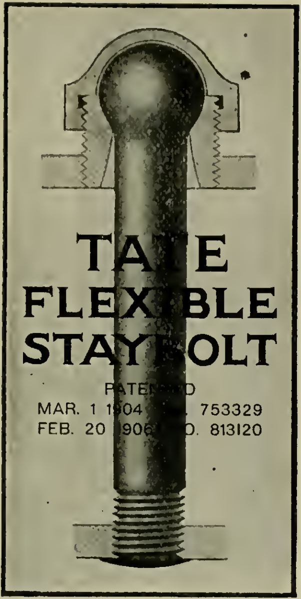

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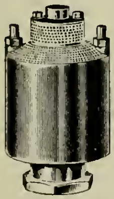

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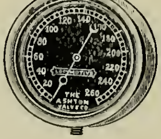

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INDEX—ADVERTISERS.

NAME Page
American Brake Shoe & Foundry Co........ iii
American Locomotive Company.. viii
Ashton Valve Co........ xi
Ball Chemical Co........ ii
Brady Brass Co........ Front Cover
Butler Drawbar Attachment Co... xviii
Chicago Pneumatic Tool Co...... v
Clancy, J. R........ xvii
Cleveland City Forge & Iron Company........ Front Cover
Crosby Steam Gage & Valve Co... v
Damascus Brake Beam Co........ xvii
Dixon, Jos., Crucible Co........ vi
Flannery Bolt Co........ xi
Fort Pitt Malleable Iron Co...... xii
Franklin Manufacturing Co....... viii
Galena-Signal Oil Co........ xii
Gold Car Heating & Lighting Co.. vi
Gould Coupler Co........ ii
Gray-Thurber Automatic Train Control and Signal Co. of America........ x
Homestead Valve Mfg. Co........ iv
Hunt-Spiller Mfg. Co........ xi
Ingersoll-Rand Co........ x
Lawrenceville Bronze Co........ xv
Lino Paint Co........ Back Cover
Long, Chas. R. Jr. Co........ iii
Magnus Metal Company........ vi
Manning, Maxwell & Moore...... iii

NAME Page
McConway & Torley Company.... xv
Nathan Manufacturing Co........ iv
National Car Wheel Co........ iii
National Malleable Castings Co... vi
National Tube Co........ i
Niles-Bement Pond Co........ ix
Page Woven Wire Fence Co........ Front Cover
Peerless Rubber Mfg. Co........ xvii
Pittsburgh Coal Co........ iv
Pittsburgh Equipment Co.. Back Cover
Pittsburgh Testing Laboratory........ Front Cover
Pressed Steel Car Co........ xx
Railway Steel Spring Co........ xvi
Safety Car Heating & Lighting Co. xvi
Sipe, James B. & Co...... Front Cover
Standard Coupler Co........ xix
Standard Steel Car Co........ xviii
Steel Car Forge Co....... Front Cover
Suydam, M. B. Co........ Back Cover
Union Spring & Mfg. Co........ xiv
Union Steel Casting Co........ xix
Ward Equipment Co........ xix
Washington Coal & Coke Co...... ix
Western Railway Equip. Co. Front Cover
Westinghouse Air Brake Co...... vii
Westinghouse Electric & Mfg. Co. vii
Westinghouse Machine Co....... vii
Wood, Guilford S........ Front Cover

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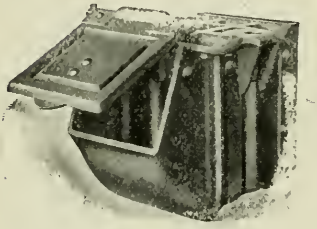

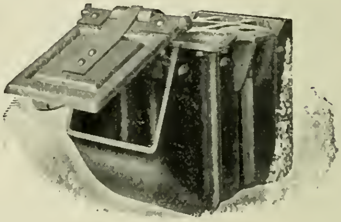

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of the

Railway Club *of* Pittsburgh.

ORGANIZED OCTOBER 18, 1901.

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Meetings held fourth Friday each month, except June, July and August.

PROCEEDINGS OF MEETING, MAY 26th, 1911.

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8:00 o'clock P. M., with President F. R. McFeatters in the chair.

The following gentlemen registered:

MEMBERS.

Albree, Chester B.
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Beatty, E. A.
Bell, W. K.
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Cox, P. L.
Demko, J. H.
Drake, Thos. E.
Drake, W. C.
Falkenstein, W. H.
Flaherty, P. J.
Flanigan, A. C.
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Freshwater, F. H.
Gilg, Henry F.
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Hauger, D. M.
Hauser, W. M.
Howe, D. M.
Huvett, E. G.
Jack, C. H.
Jones, Edward A.
Kelly, Harry B.
Kennedy, Jas.
Keptner, J. B.
Kirk, T. S.
Kleinhans, H.
Lanning, C. S.
Lanning, J. Frank
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Lynn, Samuel
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Painter, Joseph
Peach, W. M.
Pechstein, Albert J. G.
Pfeil, John
Phelps, W. H., Jr.
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Proven, John
Quest, W. O.
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Schreiner, W. C.
Smith, Geo. H.
Stucki, A.
Taylor, H. G.
Thurly, A. R.
Toomey, J. J.
Unger, J. S.
Warnock, E. H.
Warnock, H. R.

Weiss, W. W.
White, F. L.
Wood, Ralph C.

VISITORS.

Baker, C. L.
Beattie, J. A.
Carrick, G. S.
English, A. F.
Fox, J. B.
Froelich, J. H.
Gaus, E. E.
Greenough, G.
Guay, John W.
Gunmeere, W. P.
Hualtz, M.
Johnston, Robt.
Lang, W. C.
McCloy, J. H.
Peach, W. O.
Pearson, A.
Rogers, John D.
Rommel, C. T.
Rothemich, E. J.
Smith, A. C.
Smith, Sion B.
Weber, C. J.
Wieser, G. F.
Wills, J. F.

The reading of the minutes of the last meeting was dispensed with, same being in the hands of the printer.

The Secretary read the following list of applications for membership:

Andrews, Fred. G., Lumber Dealer, Arrott Building, Pittsburgh, Pa. Proposed by Samuel G. Stafford.

Baker, C. L., Chief Clerk, Carnegie Steel Co., Car Accountant, Pittsburgh & Ohio Valley Ry., Vance Ave., Coraopolis, Pa. Proposed by Wm. A. Sargeant.

Carpenter, Harry L., Central States Representative, Ajax Metal Co., Westinghouse Building, Pittsburgh, Pa. Proposed by Wm. I. Parry.

Drawbaugh, E. L., Chief Car Inspector, Cumberland Valley R. R., Chambersburg, Pa. Proposed by E. J. Leonard.

Froelich, J. H., Assistant on Engineer Corps, P. C. C. & St. L. Ry., 39 North Linwood Ave., Crafton, Pa. Proposed by Harry Edgar Boyle.

Heady, T. B., Sales Agent, Vulcan Crucible Steel Co., Aliquippa, Pa. Proposed by Samuel G. Stafford.

Hokanson, M., General Manager, Iron City Testing Laboratory, Phipps Power Building, Pittsburgh, Pa. Proposed by Samuel G. Stafford.

Little, P. C., General Manager, Cleaning Devices Mfg. Co., Empire Building, Pittsburgh, Pa. Proposed by H. A. Pratt.

Low, John R., Chief Clerk, Duquesne Steel Foundry Co., Coraopolis, Pa. Proposed by L. A. Way.

McCloy, John H., Salesman, Zug Iron & Steel Co., Thirteenth and Etna Sts., Pittsburgh, Pa. Proposed by A. M. Brown.

Stein, L. H., Inspector, Rock Island Lines, Oliver Building, Pittsburgh, Pa. Proposed by A. M. Brown.

Wallace, Jos. A. S., Traveling Freight Agent, C. M. & St. P. Ry., Room "D," Park Building, Pittsburgh, Pa. Proposed by Milton T. S. Orner.

PRESIDENT: When these applications have been approved by the Executive Committee, the gentlemen will become members.

If there is no further business, we will proceed to the paper of the evening, on "Choosing a Locomotive," by Mr. G. Greenough, of the Baldwin Locomotive Works, Philadelphia, Pa.

CHOOSING A LOCOMOTIVE

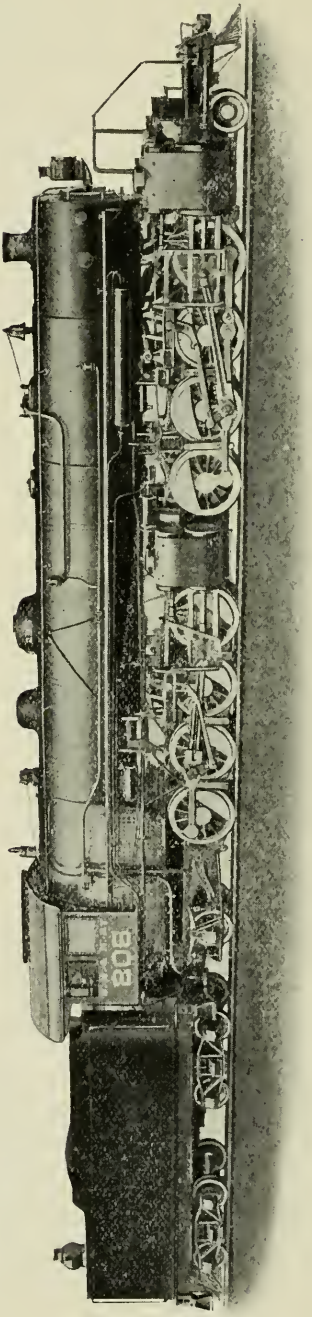
BY MR. G. GREENOUGH, SALES MANAGER, BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA, PA.

So much is continually published of a more or less technical nature concerning locomotives, and so many inventions and proposed departures from approved designs are exploited from time to time, that it is hardly possible to present a paper along such lines which would be free from repetitions of what has been said before, and which would not to a substantial extent confirm the defiant challenge to inventors, attributed to Solomon, in the assertion "there is nothing new under the sun." Perhaps the preacher was nearer right and his words may ring more truly today than many admit, for with all our boasted knowledge and laboriously-gained engineering skill, we rank as amateurs when our efforts are compared with the daily exhibitions of natural force. For ease in locomotion fishes excel our boats; flying machines are but a clumsy imitation of the birds, and our puffing and snorting locomotives cannot approach the precision and silent sweep of the planets as they travel their unseen tracks. Amid the rush after new ideas we realize our limitations, and this realization is the greatest factor which impels our search for something new. Yet often, like Homer, we find "old songs turned up again," like ghosts resurrected in new form. It is, therefore, well to pause occasionally while traversing the field of ideas so we may separate the wheat from the chaff and take that which may be useful, whether old or new, and leave the rest alone, so that in choosing a locomotive we shall choose well.

The need of more care in the consideration of locomotive details was brought to my mind during a recent visit with Mr. D. F. Crawford, and I spoke of our interview to your Secretary with the result that I am honored with the opportunity to open the discussion this evening, hence it may be said this paper has sprung from Pittsburgh seed, nurtured in Philadelphia and transplanted to its native soil.

With your permission, let us consider the choice of a locomotive from its incipiency. The preparation of specifications covering a locomotive, best suited for stipulated work under given conditions, is not always an easy task. Owing to limitations often encountered the locomotive designer's efforts are exerted under conditions not unlike the old Hebrew task of making bricks without straw, and what may be profitably done and what left undone must be as carefully weighed and as carefully balanced as a banker's account.

Locomotives are limited in length by turntables, curves and roundhouses; they are limited in height by tunnels, bridges and overhead work, but most important of all, they are limited in width primarily by the gauge of road, and, secondarily, by track centres and adjacent permanent structures, whilst the weight is limited by the stability of the roadway and the size of the rails. Although it is possible to modify all of these factors, it is not probable that we shall soon see a change from what we term our standard gauge of road, and as we have reached the practical limits as to the diameter of locomotive boilers and the height at which we may safely carry them, the only growth in locomotives



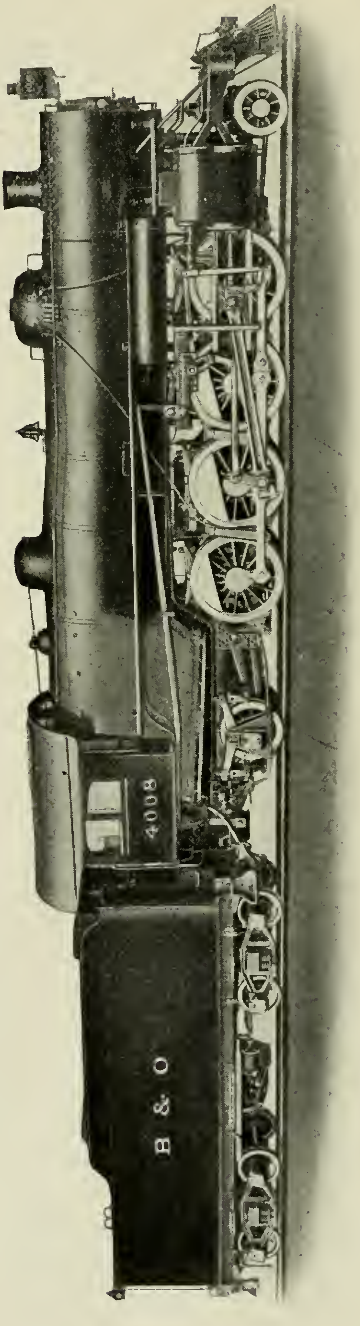
Mallet Articulated Compound Locomotive, Duluth, Missabe & Northern Railway practicable with our present gauge of track must increase their length. We may ignore the limitations of narrow-gauge roads, because generally such roads are made standard gauge as soon as traffic warrants the change. Commonly the earlier locomotives were provided with a single pair of driving wheels placed front or back, with a pair of carrying wheels supporting the other end of the engines, but as more power was required and the safe weight per wheel of the roadway was exceeded, additional drivers were added to provide requisite adhesion, and truck wheels or carrying wheels were at times added, either to aid the engine in curving or to support overhanging weights, until from the modest beginning of four wheels attached to a frame, a modern locomotive may possess twenty or more wheels connected together by elaborate frames and equalizing arrangements. The reasons for multiplying wheels are constant, but as the improvements in roadways and in locomotives have alternated, we find that an increase in the number of wheels commonly used at a certain period is followed by improvements in roads and superstructures, thus for a time nullifying the necessity of more wheels; hence we find four-wheeled locomotives of today which weigh more than earlier engines of classes having several times that number of wheels. The whip-lash of need and the hunger of demand unite to exact more and more from the locomotive engine; thus more power is required, which in turn demands larger cylinders, larger boilers to feed them, more weight on drivers for adhesion, until the limit of weight per wheel is reached, and then again more drivers, and so on ad infinitum. Our reference, therefore, a moment ago to changes in the driving wheels, applies in a sense to all parts of the locomotive. So continual is this change in demand that the receipt of orders from the railroad companies for duplicates of engines previously furnished is rare enough to excite comment. Even railroads which are keenly alive to the advantages of standardization, are not only adding new classes to their locomotive equipment, but new sizes of old classes. Whilst the gauge of track is the most uncompromising limit we meet, yet in nearly all cases we encounter other limitations, and the adjustment of our locomotive design to these limitations makes the majority of our engines a compromise between what they should be and what they may be. It is because of the differences of opinion which attach themselves to every point of locomotive construction, including the compromises demanded by outside conditions, which render it impossible to formulate rules that would enable us to turn out a series of consistent designs without deviation. Aside from the foregoing which has to do with limits as to size, locomotives must be designed to use various kinds of fuel and water, and these of varying qualities. Hence, when we consider the difference in the opinions of those designing locomotives regarding all factors involved, it is but natural to find locomotives intended for similar work as dissimilar in design as it is possible to make them. To add to the confusion, locomotives have been regarded by inventors, both skilled and unskilled, as their legitimate prey, and every part of the locomotive has been designed again and again; and not only do inventions long since dead enjoy resurrection, but they crop up with new masters. We are daily in receipt of propositions from itinerant inventors; most of their efforts die in infancy, some live long enough to acquire sponsors, and a few, but ever so few, continue to exist after a trial.

Notwithstanding the immense number of ideas which are discarded as useless, a sufficient number of different ways of performing nearly all the functions of a locomotive are considered practical by enough adherents to warrant their continuance, and whilst we have not time this evening to even catalogue these items we will consider some of the most important.

With regard to wheels, it is a simple matter to determine upon the number required to provide sufficient adhesion for a given amount of power on a roadway of given carrying capacity. Having determined the tentative number of driving wheels of size suitable for the maximum speeds to be attained, we must decide whether the service warrants the use of a forward truck, either with single or double pairs of wheels. If the fuel is good and the service not severe we can probably obtain sufficient heating surface and grate surface for the required horse power with a boiler which can be carried upon our tentative number of wheels, but if the requisite boiler capacity cannot be obtained without overloading, we must increase the number of wheels, either by adding to the drivers and increasing our ratio of adhesion unduly, or by lengthening our boiler beyond the drivers and adding a pair of trailing wheels to support it. In many cases, although trailing wheels are dead weight, their use is advisable, because on account of their small diameter, as compared with driving wheels, a deep firebox can be obtained without unduly raising the centre of gravity of the locomotive. Then again, they are of vital importance for engines designed to run backwards. Cylinders of sufficient volume must be used to furnish requisite tractive power at a pre-determined boiler pressure, and then by providing tanks and coal boxes for water and fuel, either on the engine itself or on a separate tender, we have our design of locomotive in embryo.

If tracks were straight and if clearances permitted this method could be pursued indefinitely and the number of wheels increased accordingly, but in many cases curves interfere with the ideal wheel distribution of small locomotives, as well as large ones, and it is necessary to limit the number of wheels which are held in rigid line. Hence a means of adding wheels without increasing rigid wheel bases must be resorted to; thus we have recourse to flexible locomotives of both rod and geared types, including Fairlie, Mallet and Garratt designs.

Having settled what might be termed the fundamental outline of the locomotive, we are confronted with the choice of numerous alternatives concerning as many details as we care to consider. The question as to whether boilers are to be what is technically known as straight or wagon top is quite disturbing to some minds. If, owing to reversing grades, it is found difficult to provide for sufficient water over the crown sheet, some advantage may be gained through the use of wagon top boilers, because by reducing the volume of water carried at the front end of the boiler the level at the back end can be more constantly maintained when changing from up-grade to a down-grade, or vice versa. If, however, the road is comparatively level the most logical reason for choosing the type of boiler lies in the maintenance of the balance of the locomotive through a proper distribution of weight. Hence, aside from grade considerations, it is usually found advisable to use straight boilers on engines having no trucks or only two-wheeled trucks in front. Notwithstanding the simplicity of this problem we find numbers of locomotives poorly balanced, because their purchasers insist upon the use of an unsuitable type of boiler in order that certain preferences may

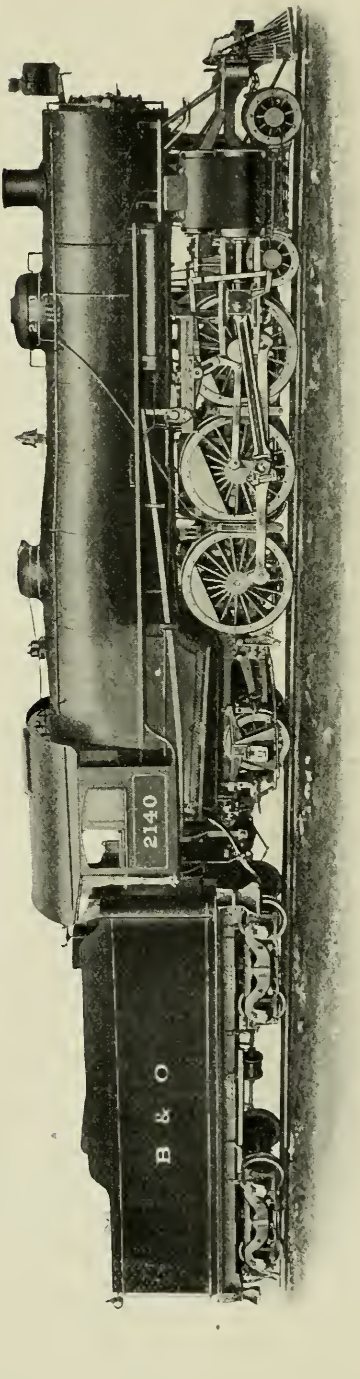


Mikado Type Locomotive, Baltimore & Ohio R. R.

be carried out. Whether or not the engine is to have a wide firebox or a narrow firebox depends upon the permissible length of the firebox, owing to mechanical restrictions, which naturally include the question as to whether or not trailing wheels may be used to support the firebox, whilst from an economic standpoint the size and shape of firebox should be governed by the kind of fuel which will be used. It is pretty generally admitted that a large firebox will burn fuel more economically than a smaller box, but on the other hand the first cost of the large firebox and the amount of repairs it requires are greater.

In addition to the foregoing a number of questions arise which may be termed more or less technical. For twenty years and over the use of compound cylinders on locomotives has been more or less prevalent and compounding has been effected in numerous ways with varying results. The most generally accepted system of compounding, known as the Vauclain Four-Cylinder Type, within a few years sprang into use that bid fair to become general, and the decline in popularity was just as marked, notwithstanding many engines so equipped proved exceptionally efficient. An analysis of the situation may account for this change in opinion. To begin with, the maximum economy of compound locomotives is coincident with maximum work, and the drop in economy increases more rapidly than the reduction in work. Hence an engine equipped with compound cylinders must be worked to its capacity to effect full economy, and it necessarily follows that any reduction from the maximum rate of work will reduce the percentage of saving effected by compounding. If a locomotive could be worked to its capacity 100% of the time that it is in service, ideal economy due to compounding could be realized, but as very few locomotives work to their capacity even one-half of the time, something less than one-half of ideal economy in fuel and water is obtained. I had occasion at one time to investigate the comparative merits of compound and single expansion engines on a single-track railroad where traffic was congested and where more time was spent on side-tracks than on the main line, and I was naturally forced to the conclusion that both compound and single expansion engines would burn about the same amount of fuel in given sized fireboxes while standing still. This, of course, was an extreme case, but yet an actual one, and it is needless to say that the management of the railroad company was disappointed in the performance of their compound locomotives. Each additional piece of machinery added to a locomotive means additional expenditure both in first cost and in repairs. The builders of the locomotives cannot supply it without compensation, and a certain amount of work which costs money must be expended in its inspection and maintenance. Hence, as a general proposition, compound locomotives are subject to increased first cost and maintenance. Therefore. the only reasonable excuse for their use must lie either in the performance of more work than a single expansion engine of similar size or in accomplishing the same amount of work more economically. Another peculiarity of compounding lies in the fact that whilst compound engines could be designed to perform any given work more economically than single expansion engines, yet the drop in economy under varying loads and speeds was greater than for a similar variation in work when performed by single expansion engines. A little reflection, therefore, shows that a large majority of compound locomotives should never have been placed in the service for which they were built. At this day it seems almost incredible to believe that we were asked to build compound engines for switching work, elevated railroad work, and even for mining engines operated by compressed air, which seldom worked to capacity and exerted only intermittent effort. Had the matter been thought out soberly it is possible the mistakes of the past might have been avoided, and had such conservative action been taken, doubtless the demand for compound engines would have continuel. In the construction of marine engines, stationary engines, and machinery generally of values far less than locomotives, we find a disposition to give plenty of time to the design, but the purchase of a locomotive is a unique operation. Often orders are deferred until the locomotives should be in service and the builder is expected to make delivery as quickly as the engines can be rushed through the shops, without allowing time for designing. As a matter of final economy each question concerning the design of locomotives should be weighed carefully, and answered only after the component factors have been placed on the plus or minus side of the account to ascertain what is of value. But, strange to say, there is often no disposition to avoid being carried away by some good or bad report which is accepted without further investigation, so we find many compound locomotives were ordered, we may say, because they were in style and with as little reason was their use abandoned. One might liken such choice of design to the selection of fashions following which we copy a popular mode of dress without knowing why.

The so-called four cylinder compound gave place on some railroads to the balanced compound, which is only practicable for certain types of locomotives because of the crank axle, which is an inherent feature of construction, and because of the difficulty experienced in providing inside connected main rods of proper length. Cross compounding has been introduced to a limited extent with fair results. These types of compounding are free from certain mechanical disadvantages embodied in the crossheads of four-cylinder compounds, but regarding general compound features they are subject to the same analysis. The revival, however, in the use of compound locomotives at this time is doubtless due to an indirect cause, namely the introduction in this country of Mallet type locomotives, which incidentally afford the possibility of providing the most common-sense design of compound locomotive yet devised, because the two sections of a Mallet locomotive are virtually two complete single expansion locomotives, insofar as working parts and cylinders are concerned, except that one set is provided with a larger set of cylinders and the steam from the smaller cylinders is exhausted into the larger cylinders instead of into the open air. In the Mallet type of locomotive we obtain ideal results from compounding, because the economy in fuel and water is not offset by relatively greater costs of repairs based on the weight of the locomotives. For slow speed, heavy drag work or for pusher work this type of locomotive stands unapproached, but speeds can only be increased after the most careful provisions are made therefor, and then the speeds attained are only moderate. The Mallet locomotive of large size is restricted as to speed partly because of the limited room for exhaust passages and because on sharp curves the swing of the exhaust pipes must at times be accomplished by reducing the exhaust pipe size below that necessary to free the low pressure cylinders from back pressure efficiently. For this reason



Pacific Type Locomotive for the Baltimore & Ohio R. R.

some engines of what may be termed the "Duplex Type," having all high-pressure cylinders, have been designed, in which the economies due to compounding have been abandoned so that the requisite speed may be attained. Briefly, the reason for using flexible engines lies in the degree of curvature they must traverse. Were it not for the curves the engines could be built on rigid frames and the troubles incident to the use of flexible pipes for carrying steam and exhaust might be avoided.

The decision as to the use of Mallet and kindred type engines usually depends upon the disposition of train movements on the roads upon which they are to work. Such engines frequently make such a reduction in train movements possible that the question of engine economy is thrown into the background by considerations of operating economy.

Now let us turn for a moment to the valves and valve gear. With the advent of compound locomotives came a more general use of piston valves—even for single expansion engines.

Piston valves are better balanced by the steam pressures than slide valves, but they do not remain as tight and hence allow more steam to leak, and as they cannot lift from their seats as slide valves do, they cause more broken cylinder heads. As regards repairs, the two types are about even. In fact, honors would be about even between piston and slide valves were it not for the increased first cost of piston valves.

Until the Pennsylvania Railroad Company took an active interest in the Walschaerts valve gear, Stephenson link motion had practically supplanted all other gears in this country. The Stephenson link motion, when properly designed and kept in order, has proven a very efficient arrangement, and because of its variable lead is still preferred by many to either Walschaerts valve gear or other gears placed outside of the locomotive frames. In many cases a valve gear placed outside the frames and wheels is more accessible than the Stephenson link motion, and it is also apparent that the troubles due to the difficulty experienced in oiling eccentrics and their straps, when of large size, are avoided. But when the eccentrics are of normal size and the Stephenson link motion can be made accessible, there is no reason for using an outside gear at an increased cost, especially when the outside gear effects no economy in fuel or water. Several makes of outside gears in rivaling the Walschaerts are now being tried, viz: the Baker-Pilliod and the Hobart-Allfree.

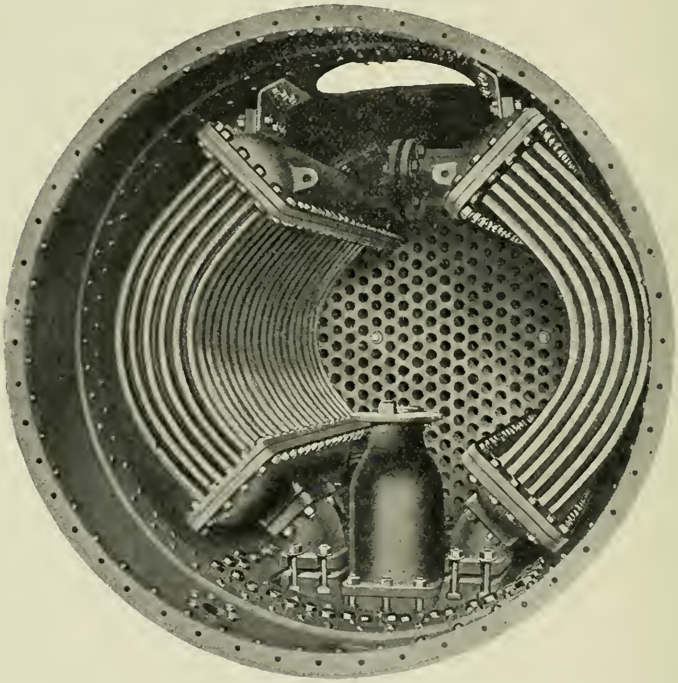
The novelties in boiler construction are largely confined to the firebox end. In order to reduce the number of broken staybolts numerous roads are using various types of flexible bolts. From time to time a bold endeavor to eliminate the use of staybolts is made. The first of these to gain prominence was embodied in the Strong locomotive, which was tried on the Lehigh Valley Railroad, and in more recent years the Vanderbilt type of locomotive boiler appeared, both of which were built with corrugated fireboxes, but in each of which poor circulation forced a speedy retirement from actual use.

The most recent effort along these lines is the Jacobs-Shupert firebox now fairly introduced on the Atchison, Topeka & Santa Fe Railway. In this firebox staybolts are replaced by perforated sheets riveted between adjacent sections of the firebox. This mode of construction is quite strong and does not interfere with the steaming qualities of the locomotive. Much difference of opinion exists regarding the staying of locomotive boiler fireboxes. Whilst some think the staybolt is entirely inefficient, others are of the opinion that staybolts, with all their faults, are less trouble and involve less expense to maintain than the substitutes which supplant them.

There is a disposition in the West and Southwest to use crude oil for fuel, both as a matter of economy and as a means of easily operating locomotives which are too large to fire by hand. From an operating standpoint, oil fuel has an important advantage. It is easily controlled, irrespective of the size of the firebox, thus making it possible to supply the largest fireboxes with ample fuel. Its relative cost, compared with coal, differs according to local conditions, and whilst the handling of oil is cheaper than the handling of coal and ashes, yet its action is more severe on fireboxes and entails increased expense for the maintenance of boilers and fire-bricks. The use of automatic stokers for coal fuel is still in its infancy and some of the efforts in this direction have doubtless failed, not so much for lack of general merit as because of poorly designed detailed parts. The majority of stokers heretofore tried must be fed by hand, consequently, as all of the coal must be shoveled by hand, the only relief they afford the fireman is that due to being shielded from the heat and from being relieved of distributing the coal in the firebox. The Crawford stoker now being introduced on some of the Pennsylvania lines, is not subject to this criticism, for it conveys the coal from the fuel space of the tender to the firebox.

The most important attempt, because it is the most radical, to economize in the use of fuel which is now under consideration is the introduction of the superheater in this country. For a number of years after the first superheaters were applied nothing like general interest could be claimed for them, but at the present time we seem just as determined to superheat by wholesale as we were to compound some years ago. Saturated steam, or steam which is in contact with water, contains a certain amount of heat, both latent and sensible, which corresponds with a given pressure per pound at given altitudes. Hence when steam is introduced into a cylinder that is exposed more or less to the air, and is, therefore, of lower temperature than the boiler, the steam is perceptibly chilled and loses pressure proportionately. Owing to a peculiar property it is possible to add to the heat of steam after it has separated from the water from which it was generated and thus increase its temperature beyond the normal temperature of steam under the pressure which may exist. If this superheated steam is thrown in contact with a cooling surface, such as the cylinder, the additional degrees of heat or the superheat must first be dissipated before the usual condensation takes place, thus affording greater efficiency than can be obtained from a given volume of saturated steam of the same pressure; but, on the other hand, a greater amount of heat must have been imparted to the superheated steam than to the saturated steam, consequently it behooves us to ascertain where the additional heat was derived from and whether or not we have been obliged to pay more for the additional heat, or the superheat, than we have obtained from it in increased efficiency.

In locomotive practice there are two distinct methods of superheating steam. One is known as the smokebox superheater and the other as the smoke tube superheater. The former type is placed in the smokebox of locomotives, where it absorbs the heat which would otherwise pass out of the stack. Two types of smokebox superheaters are in use, notably the Vauclain, where steam passes through the tubes, and the Jacobs and Buck, where the steam is outside of the tubes. Smokebox superheaters are installed without reducing the saturated steam heating surface of the boiler in any manner whatever, hence the superheat obtained through their use is a direct gain, as regards economy of fuel, from which, of course, the first cost, maintenance and care of the superheater must be deducted. Such superheaters only yield a moderate amount of superheat, say from 40 to 60 degrees, but yet sufficient to insure dry steam in the cylinders. Smoke tube superheaters, on the other hand, are installed in longitudinal tubes larger than the regular boiler tubes, which displace from one-quarter to one-third of the normal number of boiler tubes and hence which reduce the saturated steam heating surface of the boiler considerably. There are several types of these superheaters in use, among them the Schmidt, Vaughan, Emerson, and



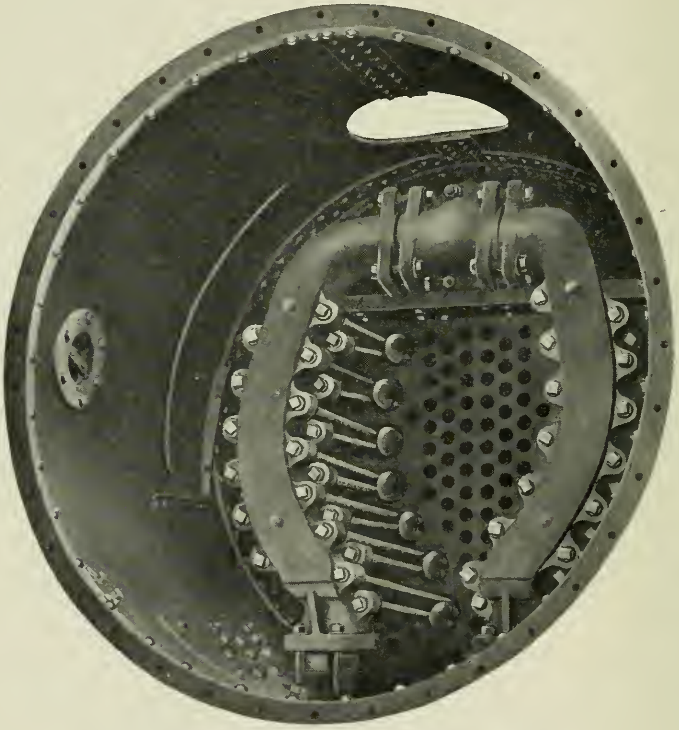
Vauclain Smokebox Superheater

Cole, all of which are similar in principle, differing only in modes of application and in mechanical details. Owing to their proximity to the fire, smoke tube superheaters can be designed for any given amount of superheat, and are usually operated at much higher temperatures than smokebox superheaters. The low superheat obtained with the smokebox superheater does not interfere with the use of slide valves, whilst superheat of 100 degrees or more renders it desirable to use piston valves, which, owing to their balance, can be lubricated more readily. The economy due to the use of smoke tube superheaters is only due to the difference in the efficiency of superheated steam as compared with saturated steam, assuming that an equal number of heat units have been absorbed by each, from which economy must be deducted the first cost of the superheater, its maintenance and repairs. The care of the smoke tube superheater is more arduous than the care of the smoke box superheater, because of the liability of the large tubes to clog and thus not only destroy the value of the superheating surface of the small tubes of the superheater, but render useless the saturated steam heating surface of the large tubes in which the superheater is installed.

The arguments for and against the use of the superheater are in a measure akin to those affecting compound locomotives; in fact, there is a disposition on the part of some to assert that the superheater is the logical successor of the compound locomotive, but, on the other hand, notwithstanding assertions to the contrary, some believe that a certain amount of additional economy can be effected by using superheated steam in compound cylinders.

One of the greatest drawbacks encountered in installing superheaters is their tendency to wire-draw the steam which passes through the superheater and thus decrease the efficiency of high-speed engines. Until quite recently it was considered essential to only superheat steam of comparatively low pressure, say 155 or 160 pounds boiler pressure, in consequence of which the size of the cylinders was increased proportionately, but it is now becoming common to use higher boiler pressure and make some reduction in the diameter of the cylinders as compared with the older superheater practice. Hence we have not credited the superheater with a saving in boiler maintenance because of low pressure. In all cases it is necessary to make the size cylinders to suit the mean effective pressure which may be expected from the particular superheater, bearing in mind its wire-drawing tendencies.

Just as regards the compound locomotive we are inclined to the opinion that unless careful investigation insures for superheater engines a net economy, a simpler form of engine is advisable.



Smoketube Superheater Emerson Type

If because of restricting factors a locomotive is so limited as to be disproportioned, superheating may be resorted to as a means of increasing efficiency and perhaps economy, but if such limitations do not exist and if a boiler is designed to absorb all of the heat which the firebox can generate, conservative practice would favor for ultimate economy, a properly designed saturated steam locomotive, rather than a superheater engine, with its first cost, cost of repairs, cost of cleaning, and cost of fuel lost in order that the cleaning may be accomplished.

The use of superheaters is too recent to permit of a definite solution of the problem at this time, but when the comparisons are made they should be between engines equally well designed and differing only in the parts affected by the superheaters. The trials should be made in actual service and last through a period of time long enough to enable the cost of repairs to signify.

Numerous reports as to economies due to the use of special devices are made from time to time, but very few of them are on a basis which is strictly comparative. We often find upon investigation that the locomotives compared are so dissimilar in numerous ways that it is impossible to more than approximate what economy or increased expense may be due to any one item. This difficulty also holds where several new devices have been applied to the same engine, so that their respective merits cannot be separately determined.

To conclude, I would urge in "choosing a locomotive" that it be provided with ample power, ample boiler capacity and enough wheels to insure good carrying qualities without overloading the roadway and with adequate fuel and water capacity.

I would make the design as simple and as free from complications as limiting considerations permit.

Before admitting any complications, I would make sure they are advisable and that the account is on the right side after all factors have been considered, bearing in mind that an extra engine failure or an extra turn in the "back" shop outweighs a very large percentage of figured economy.

PRESIDENT: Gentlemen, the subject is now before you for discussion; if any one has a question to ask Mr. Greenough, I feel certain he will be pleased to answer. Mr. W. L. Hudson, may we hear from you?

MR. W. L. HUDSON: I think the paper was so ably handled that further remarks from me would be entirely out of place.

PRESIDENT: Mr. Gurry, have you anything to add?

MR. GEO. GURRY: The subject has been very ably presented and I have enjoyed it very much. I do not know that I have anything to add.

PRESIDENT: Mr. Redding?

MR. D. J. REDDING: I do not see that there is very much to discuss, Mr. President. Mr. Greenough has given us a very good general history of the locomotive situation. There are a few questions I might ask, if I may be permitted.

One of the things Mr. Greenough spoke of was the increase in cost of maintenance of superheated engines, particularly on account of the tubes stopping up. I would like to ask him if he has taken into consideration the use of the later designs of arches, which are supposed to prevent the passage of a very large portion of the cinders. We have some superheater engines that have been in use now for several weeks, and so far we have not found any necessity for excessive tube cleaning. I discovered the other day at one of the round-houses they had not been supplied with blowers for blowing out the large tubes and did not seem to have learned that they needed them. I would like to ask as to the relative economy between compound locomotives and superheated locomotives, assuming that you want to do something to increase the efficiency of the locomotive. If you had conditions which would make it desirable to get something a little better than a saturated steam locomotive, for instance; you have about reached the limit in that respect in a certain class of service. I would like to ask if the speaker has looked into the question of the relative increased efficiency as between superheating and compounding?

He also spoke of the trouble to be expected from the use of slide valves with superheat. We have not had enough experience yet to know whether we should expect trouble along that line. I would like to ask if his experience has gone far enough with superheat to know whether a different grade of cylinder oil than that ordinarily used, or a better system of applying it, either by forced feed lubrication or in some other way, would solve that difficulty? That is referring to the use of well balanced slide valves as well as piston valves.

MR. GREENOUGH: Taking the questions in the order in which they were presented, first we are asked as to the newer designs of superheaters, as to whether the difficulty through clogging up is as apparent in them as in the older superheaters. Is that the idea?

MR. REDDING: What I had in mind is where the later design of arch brick equipment is used.

MR. GREENOUGH: We find that the clogging of the large tubes containing smoke tube superheater unit depends more upon the kind of coal used and the service in which the engine is employed than upon the nature of any details of firebox construction. Of course, the use of improved brick arches would aid superheater tubes to some extent, as they might aid in clearing the regular boiler tubes.

It may possibly be that the engines are being worked under ideal conditions for the superheaters, and I imagine they are being used where they have a long, continuous pull. Is this not correct?

MR. REDDING: Passenger service, heavy train.

MR. GREENOUGH: Frequent stops, or pretty long runs?

MR. REDDING: No, not frequent stops.

MR. GREENOUGH: Under those conditions, which are ideal both for superheating and for compounding, the passage of gas through the pipes is more or less constant. The troubles of which I have previously spoken are not as apparent under such conditions as where the work is intermittent and where the engine is not worked hard enough for the draft to properly clean tubes.

With regard to the relative values of compounding and superheating general experience shows them to be about equal. The advocates of both claim that anywhere from 18 to 30 per cent economy may be effected through the use of either system when they are properly installed and operated to the best advantage.

Concerning lubrication, we may note that in Germany, where the application of the superheater may be said to have originated, the use of pumps to force the oil to the valve has been more or less in vogue. For a while it was believed in the old country that it was impracticable to obtain good results by using valves of the relative size which we use in this country with superheated engines. Consequently, partly because of the lubrication and partly because of the belief that a small valve was more economical, the valves of superheater locomotives were made about one-half the size of the valves for similar engines with saturated steam. Hence, not only because of this, but because of the difference in size of the locomotive, German practice as regards lubrication is not of much value to us, and we in this country will probably have to learn our own lessons. Superheating in this country is more or less in its infancy, and we may find it possible to lubricate slide valves in a practical way with high superheat, which we may place at from 150 to 200 degrees, or even higher. May I ask what superheat you obtain?

MR. REDDING: We are supposed to get 200 degrees.

MR. GREENOUGH: Well, if the 200 degrees of superheat does not cause trouble with the slide valves, the experience will indicate that you have succeeded in making a new era as far as the lubrication of slide valves in this country is concerned.

MR. REDDING: Mr. Greenough has certainly opened up a few questions which will set some of us thinking. The paper is one which I think will, on careful reading, bring forth a better realization of just how careful one should be in studying the locomotive situation before ordering. I think there is no doubt that Mr. Greenough has stated the case very clearly when he said that in many cases locomotives were put in a service for which they were not intended and not suitable. Probably all of us who have had some experience in locomotive service have seen examples of such a thing.

I feel that the Club has been greatly benefited by the presentation of this paper here tonight, and I therefore move you, Mr. President, that we extend to Mr. Greenough a vote of thanks for his very able paper.

MR. R. H. BLACKALL: In seconding the motion, I would like to say that it has been about ten years since I have had anything to do with actual railroad service. While out of the service my interest in the work has ever remained, but it has been practically impossible to keep in touch with those of the new ideas which have outlived the experimental stage. I feel as if I have been hopelessly chasing the wagon of progress, and am very glad that Mr. Greenough was on the wagon and that he stretched out his hand and helped me, with the others, aboard.

His paper has certainly been most helpful and one of the most interesting I have heard presented before this Club. There are two reasons for this, I think. One is that the paper seemed to be exceedingly complete with the information furnished, and another is that this information was so concisely put that no one could fail to understand and appreciate it.

It gives me great pleasure to second the motion.

The motion, being put to vote, was carried unanimously.

PRESIDENT: Mr. Greenough, accept the thanks of the Club. If there is nothing further, a motion to adjourn will be in order.

ON MOTION, Adjourned.

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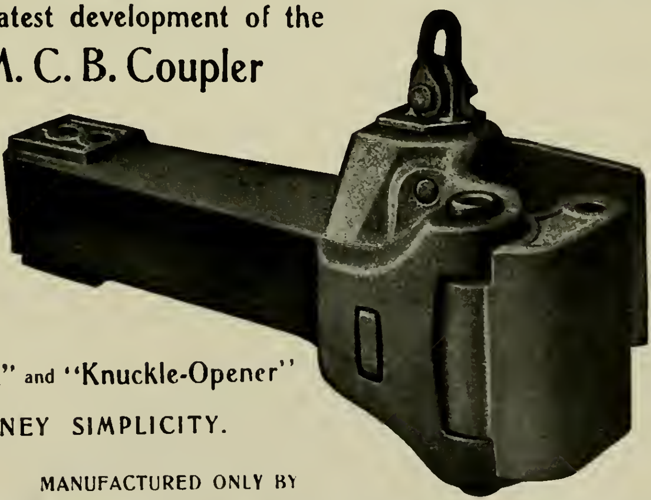

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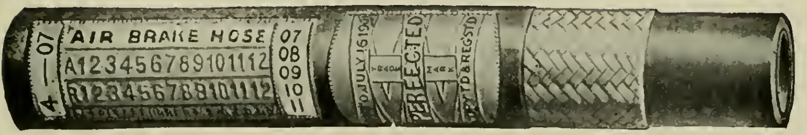

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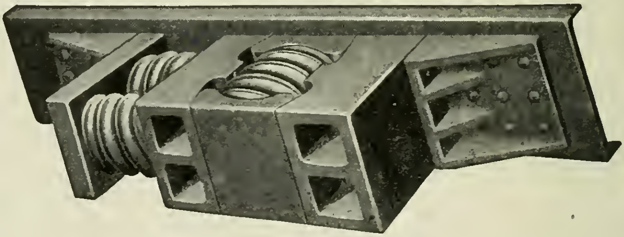

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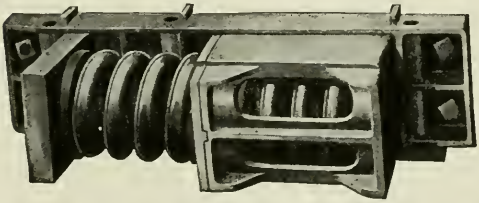

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BOILER TUBE ECONOMY

*No. 3.

MAINTENANCE COST

¶ In the April, 1911 issue of this magazine a specific instance was cited of a considerable economy resulting from the use of Steel Boiler Tubes where iron boiler tubes had formerly been used.

¶ The report in question was taken from the Official Proceedings of the International Master Boiler Makers' Association—third annual convention at Louisville, Ky., April 27 to 29, 1909.

¶ In the May, 1911 issue there was cited a supplementary report from the same source, this report having been read at the next convention of the same body, held at Niagara Falls, May 24 to 27, 1910.

¶ We now quote from 1909 Official Proceedings (page 165) (report of Boiler Inspector of one of the largest Eastern Systems).

> *"I have been handling steel flues for nearly six years. On our passenger power with iron flues, the best we could do was 55,000 to 65,000 miles from a set of flues. After adopting a cold drawn steel flue, we raised our mileage on the same class engines to 100,000, with some engines running as high as 148,000 miles on one set of flues. We have no pitting. Referring to Mr. ——— ———'s question regarding the cleaning of tubes, we found that steel tubes cleaned easier than the iron."*

¶ It should be noted that the above are specific instances not generalities.

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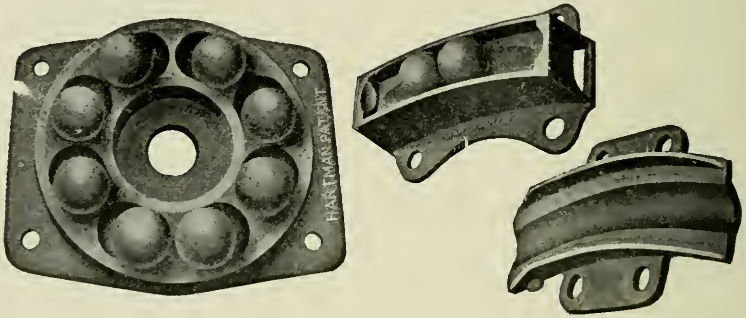

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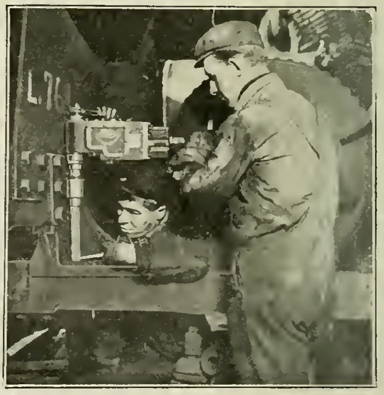

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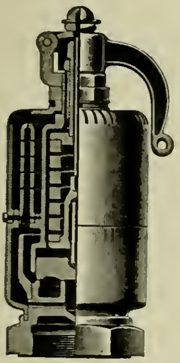

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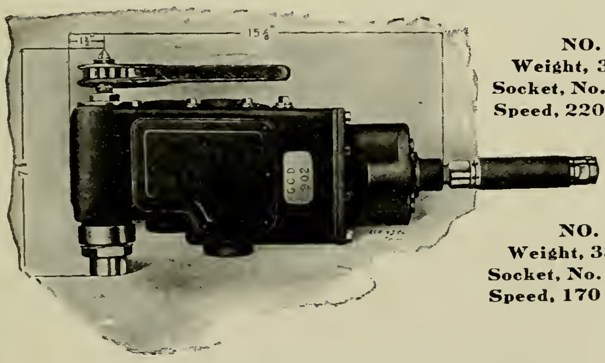

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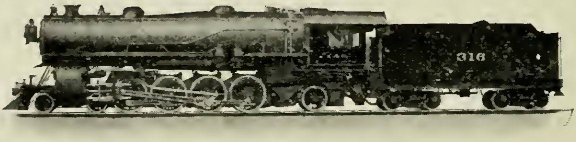

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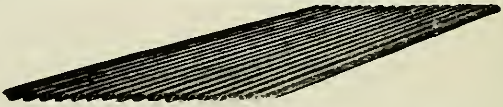

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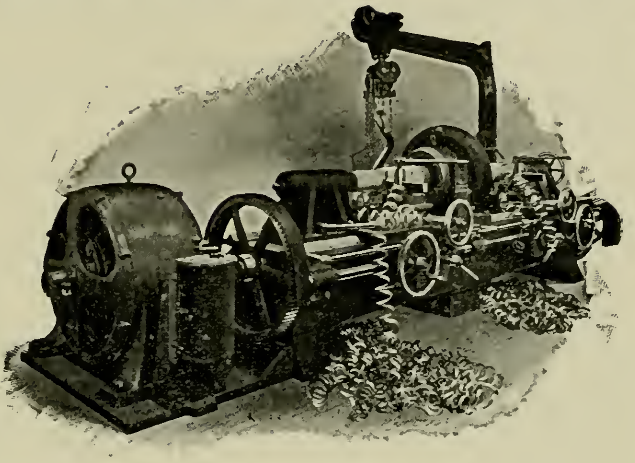

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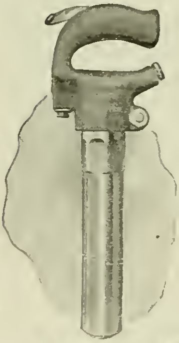

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INDEX—ADVERTISERS.

NAME	Page
American Brake Shoe & Foundry Co	iii
American Locomotive Company	viii
Ashton Valve Co	xi
Ball Chemical Co	v
Brady Brass Co	Front Cover
Butler Drawbar Attachment Co	xviii
Chicago Pneumatic Tool Co	v
Clancy, J. R	xvii
Cleveland City Forge & Iron Company	Front Cover
Crosby Steam Gage & Valve Co	v
Damascus Brake Beam Co	xvii
Dixon, Jos., Crucible Co	vi
Flannery Bolt Co	xi
Fort Pitt Malleable Iron Co	xii
Franklin Manufacturing Co	viii
Galena-Signal Oil Co	xii
Gold Car Heating & Lighting Co	vi
Gould Coupler Co	ii
Gray-Thurber Automatic Train Control and Signal Co. of America	x
Homestead Valve Mfg. Co	iv
Hunt-Spiller Mfg. Co	xi
Independent Pneumatic Tool Co	ii
Ingersoll-Rand Co	x
Lawrenceville Bronze Co	xv
Lino Paint Co	Back Cover
Long, Chas. R. Jr. Co	iii
Magnus Metal Company	vi
Manning, Maxwell & Moore	iii
McConway & Torley Company	xv
Nathan Manufacturing Co	iv
National Car Wheel Co	iii
National Malleable Castings Co	vi
National Tube Co	i
Niles-Bement Pond Co	ix
Peerless Rubber Mfg. Co	xvii
Pittsburgh Coal Co	iv
Pittsburgh Equipment Co	Back Cover
Pittsburgh Testing Laboratory	Front Cover
Pressed Steel Car Co	xx
Railway Steel Spring Co	xvi
Safety Car Heating & Lighting Co.	xvi
Sipe, James B. & Co	Front Cover
Standard Coupler Co	xix
Standard Steel Car Co	xviii
Steel Car Forge Co	Front Cover
Suydam, M. B. Co	Back Cover
Union Spring & Mfg. Co	xiv
Union Steel Casting Co	xix
Ward Equipment Co	xix
Washington Coal & Coke Co	ix
Western Railway Equip. Co.	Front Cover
Westinghouse Air Brake Co	vii
Westinghouse Electric & Mfg. Co.	vii
Westinghouse Machine Co	vii
Wood, Guilford S	Front Cover

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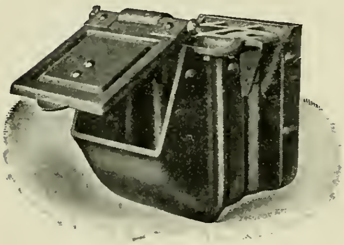

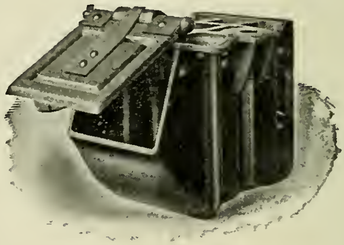

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Vol. X. No. 8 — Pittsburgh, Pa., September 22, 1911. — $1.00 Per Year 20c Per Copy

Published monthly, except June, July and August, by the Railway Club of Pittsburgh, C. W. Alleman, Secretary, General Offices P. & L. E. R. R., Pittsburgh, Pa.

Meetings held fourth Friday each month, except June, July and August.

PROCEEDINGS OF MEETING, SEPTEMBER 22nd, 1911.

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock P. M., with President F. R. McFeatters in the chair.

The following gentlemen registered:

MEMBERS.

Alleman, C. W.
Amsbary, D. H.
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Courson, C. L.
Courson, J. F.
Courtney, D. C.
Cromwell, S. A.
Crouch, A. W.
Cullen, J. C.
Cunningham, R. I.
Dambach, C. O.
Deckman, E. J.
Dobson, O. C.
Dickinson, F. W.
Drane, E. J.
Drayer, U. S.
Dussel, F. E.
Evans, H. E.
Flaherty, P. J.
Frame, R. S., Jr.
Fray, Samuel
Foreman, J. E.
Frost, John B.
Gallinger, Geo. A.
Gies, Geo. E.
Gilg, Henry F.
Gowdy, H. K.
Grewe, H. F.
Griswold, W. W.
Grove, E. M.
Guy, W. A.
Harner, A. J.
Harriman, Henry A.
Hauser, W. M.
Haynes, J. E.
Heady, T. B.
Herlehy, Thos. W.
Hokanson, M.
Howe, D. M.
Hudson, W. L.
Kelly, Harry B.
Kennedy, Jas.
Keptner, J. B.
Krause, Julius
Krepps, W. K.
Kunzhals, C. L.
Lehr, H. W.
Lobez, P. L.
Lockard, J. A.
Long, R. M.
Low, J. R.
Lynn, Samuel
Macfarlane, W. E.
Maher, J. V.
Mason, E. F.
Matthews, J. A.
Mensch, E. M.
Mercur, H. T.
Millar, C. W.
Mitchell, A. G.
McClumpha, H. E.
McDermitt, W. W.
McFeatters, F. R.
McGraw, Wm. P.
McIlwain, J. D.
McNulty, F. M.
Noland, J. J.
Orner, Milton T. S.
Peacock, W. W.
Pechstein, Albert J. G.

Pickels, H. D.
Porter, H. V.
Proven, John
Redding, D. J.
Rhodes, P. L.
Richardson, C. A.
Rupp, R. D.
Ryan, Wm. F.
Sampson, J. M.
Schauer, A. J.
Scheck, H. G.
Smith, E. B.
Stewart, S. R. B.
Stucki, A.
Summers, E. W.
Summers, J. M.
Swann, J. B.
Symington, C. J.
Taylor, H. G.
Toomey, J. J.
Trout, W. L.
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Streett, O. B.
Votach, A. L.
Ward, C. E.
Yohe, Jay.

The minutes of the last meeting having been printed, the reading of them was dispensed with.

The Secretary read the following list of applications for membership.

Buechner, W. A.—Railway Supplies, Shannon Building, Pittsburgh, Pa. Proposed by J. Francis Weisbrod.

Clark, H. L., Railway Supplies, Shannon Building, Pittsburgh, Pa. Proposed by J. Francis Weisbrod.

Detwiler, U. G., Foreman Car Shop, P. R. R., Verona, Pa. Proposed by G. C. Walther.

Ferren, Robt. O., Locomotive Engineer, Pennsylvania R. R., 1233 Franklin Street, Wilkinsburg, Pa. Proposed by W. L. Hudson.

Finegan, L., Master Mechanic, Baltimore & Ohio R. R., Glenwood, Pa. Proposed by M. O'Connor.

Geddes, Jas. R., Chief Clerk to General Manager, Monongahela Connecting R. R., Second Avenue, near Bates Street, Pittsburgh, Pa. Proposed by F. M. McNulty.

Guay, J. W., Rep., Fort Pitt Steel Casting Co., McKeesport, Pa. Proposed by C. W. Alleman.

Herr, H. W., Division Engineer, Pittsburgh Coal Co., No. 1718 Crosby Avenue, Beechview, Pittsburgh, Pa. Proposed by F. H. Stark.

Hoffman, Chas. T., Gang Foreman, Pennsylvania R. R., Youngwood, Pa. Proposed by O. C. Coho.

Johnson, Walter A., Salesman, Independent Pneumatic Tool Co., Farmers Bank Building, Pittsburgh, Pa. Proposed by Geo. A. Gallinger.

Kessler, Howard, Engine Dispatcher, P. & L. E. R. R., McKees Rocks, Pa. Proposed by R. M. Long.

Kight, H. R., Master Mechanic, Western Maryland R. R., Elkins, W. Va. Proposed by M. O'Connor.

Kinney, C. D. Master Mechanic, Kanawha & Michigan Ry., Middleport, Ohio. Proposed by M. O'Connor.

Knapp, A. D., Vice President, Nicola Lumber Co., Farmers Bank Building, Pittsburgh, Pa. Proposed by Milton T. S. Orner.

Mallen, R., Road Foreman of Engines, Baltimore & Ohio Southwestern R. R., Chillicothe, Ohio. Proposed by A. W. Crouch.

Mohler, T. A., General Foreman, Car Shops, Western Maryland R. R., Elkins, W. Va. Proposed by M. O'Connor.

Moore, Lee C., Consulting Engineer and Manufacturer, 341 Sixth Avenue, Pittsburgh, Pa. Proposed by A. Stucki.

Phillips, Jas. B., Clerk, Monongahela Connecting R. R., Second Avenue and Bates Street, Pittsburgh, Pa. Proposed by F. M. McNulty.

Raser, Geo. B., Ingersoll-Rand Co., Farmers Bank Building, Pittsburgh, Pa. Proposed by H. E. Metcalf.

Rhuark, F. W., Master Mechanic, Baltimore & Ohio R. R., Lorain, Ohio. Proposed by M. O'Connor.

Shook, S. D., Pittsburgh Manager, Star Brass Mfg. Co., Fulton Building, Pittsburgh, Pa. Proposed by F. M. McNulty.

Weiseckle, G. F., Master Mechanic, Baltimore & Ohio R. R., Cumberland, Md. Proposed by M. O'Connor.

PRESIDENT: As soon as these names have been favorably passed upon by the Executive Committee, the gentlemen will be admitted to membership.

The Secretary read a communication from Mr. Wm. Elmer offering his resignation as First Vice President of the Club, on account of his removal from the Pittsburgh district.

PRESIDENT: As this is the evening for the nomination of officers for the ensuing year, I will appoint as a Nominating Committee, Messrs. D. M. Howe, D. J. Redding and A. Stucki. I will ask these gentlemen to confer and be ready to report after the reading of the paper of the evening.

If there is no further business we will now listen to a paper by Mr. E. W. Summers, President of the Summers Steel Car Company, subject: "The Summers' Balanced Side-Bearing Truck."

THE SUMMERS' BALANCED SIDE-BEARING TRUCK.

BY MR. E. W. SUMMERS, PRESIDENT, SUMMERS' STEEL CAR CO., PITTSBURGH.

In the early 80's, 10-ton capacity freight cars were common, the capacity came up by jumps from 10 to 20, 30, 40 and 50 tons, where it appeared to have reached the limit. There are railroad officials in the Pittsburgh district who do not favor the purchase of freight cars having a capacity so small as 50 tons, and there are hundreds of cars about Pittsburgh mills that are built for and are handling 100 tons daily, but such loads are handled with care over a restricted track area.

Wheels.

The wheel problem is a serious one for 50 ton loads. With cars interchanging over the great network of tracks throughout the United States and Canada, over frogs and turnouts having wheel flange clearances originally proportioned for 20-ton cars, a condition which may never be changed, wheel flange enlargement is at the limit, yet failure and wrecks from wheel flange breakage is probably the most serious problem we have to contend with.

Center Bearing Trucks.

The almost universal custom of carrying the car and its load on a center-plate of about 12″ diameter or under, and attempting to balance this towering mass on so small a base, is a *make-shift.* A slight change in the vertical or horizontal alignment of the track will cause a well-balanced car to topple off the small center-plate, so side-bearings are provided to prevent the overturning of the car. The purpose of the small center-plate is to permit the truck to turn with small frictional resistance about its vertical axis when the car is rounding curves, but *coincident* with leaving the straight track, the car topples over onto a side-bearing, *defeating the very purpose of the small center-plate.* As an improvement over the flat side-bearings, roller bearings of various types have in many instances been provided. It has been found that there must be some clearance between body and truck side-bearings. Three-eighths of an inch is the common maximum allowance, but with many conditions of track and car this is found to permit the car to rock and pitch back and forth transversely of the track to such an extent as to reach the danger point.

Track Conditions.

The two rails of the track cannot, under all conditions, be in the same horizontal plane. In rounding curves the outer rail must have a super-elevation and the plane of the upper surface assumes a warped or spiral form. In many instances, on sharp curves, the rails are in wind or out of parallel with each other, from the center of one truck on a car to the center of the other, as much as 3 or 4 *inches.* Irregularities in tracks are unavoidable, especially in freezing weather, and 3/8" side-bearing clearance cannot take care of the twisted track condition. The result is that with the center-bearing truck, as soon as the side-bearing clearance is exceeded by the twist of the track, the car body must either become distorted, or, in case the structure is too rigid to permit of distortion, the whole load is carried on two diagonally opposite side-bearings, the center-plates at one end of the car becoming separated and at the other end contacting just enough to balance the car on a three-point support.

With *rigid car bodies* this condition has caused many derailments; in fact, where car bodies approximate a rigid structure, it has been found necessary to have the side-bearings inside of the line of the track or wheels so as to partially distribute the side-bearing load on all the wheels. This, however, with the side-bearing clearance, permits the car body to rock and sway excessively, and aside from the danger of derailment from this cause, a noseing action is set up by reason of the alternate hammering blow and consequent truck spring compression and reaction. With each surge of the car and truck from side to side of track, the wheel flanges grind on the rail heads, shearing away a portion of the respective parts of wheel and rail. This shearing action uses up tons of coal in the form of tractional resistance, which, if eliminated, will permit additional tonnage to be hauled by each power unit.

A familiar object lesson illustrating the fact that cars ride hard on the side-bearings is had by the loud popping noise and vibration of a sleeping car when rounding a curve. A side-bearing, due to the warped track and rigid car, is carrying most of the load, coincident with the turning of the truck relative to the car body. Possibly all of the late sleeping cars are provided with some form of roller side-bearing, which ought to prevent, to some degree, the gripping of the side-bearings, but it is evident that they do not always do so. I will not attempt an analysis of why they do not.

With the heavy loading of cars it is necessary to make the car body of rigid construction, and it is believed that a more flexible connection than has heretofore been in use between the truck and car body must be provided.

The Summers' Balanced Side-Bearing Truck.

The Summers' Balanced Side-Bearing Truck is offered as one means of relieving rigidity between the car and truck. It carries the entire load upon the side-bearings, located directly over the truck side frames, each bearings being a segment of a wheel of about 40″ diameter. (See Fig. 1.) This wheel segment is pivoted in the spring cap upon a generously proportioned machined journal bearing and arranged for lubrication so as to offer the least possible frictional resistance. Fig. 2 is a perspective view of a complete truck; Fig. 3 shows an end elevation. The steel cap-bearing on the rocker in Fig. 1 is riveted to the rolled steel cradle beams, which hold the cap-bearings in position on the side-bearing rocker, and are pivoted by a king-pin to the truck transom. (See Fig. 4.)

On the outer ends of the cradle beams forged steel hanger-bars are suspended with a rolling contact, and on the lower end of these hanger-bars the car body is supported through steel castings riveted to the lower edge of the car side. These also have a rolling contact with the heavy steel bars which pierce the lower ends of the hanger bars. This scheme of suspension, with rolling contacts at both top and bottom of the hanger-bar, requires no lubrication.

The term—"Balanced Side-Bearing Truck"—is justified by the novel feature of having the *side suspension bars hung diverging outward and downward* from their cradle support to the supporting bar under the car side.

Summing up the features of this suspension, it is clear that:

First—An evenly-loaded car body on a pair of these trucks on a level track will maintain a level position.

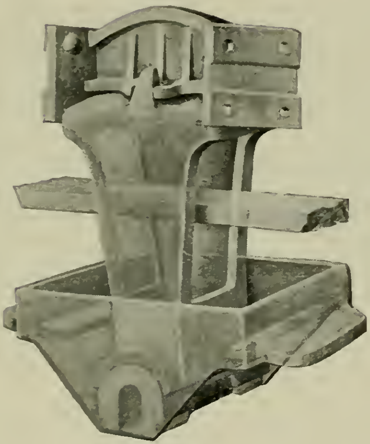

Fig. 1.

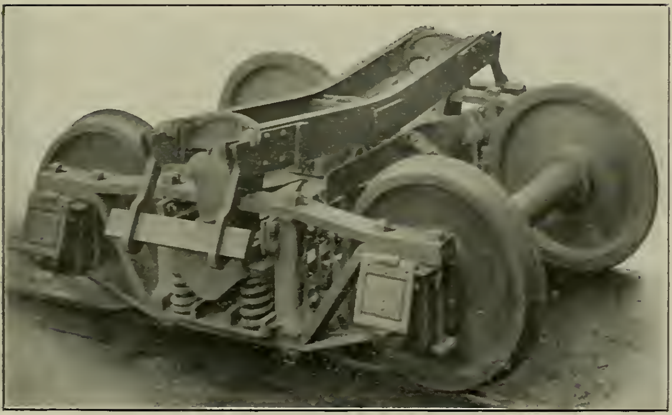

Fig. 2.

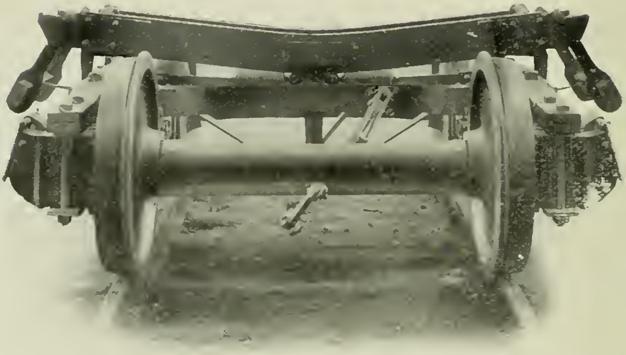

Fig. 3.

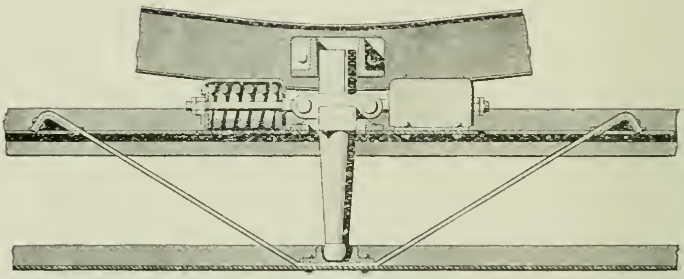

Fig. 4.

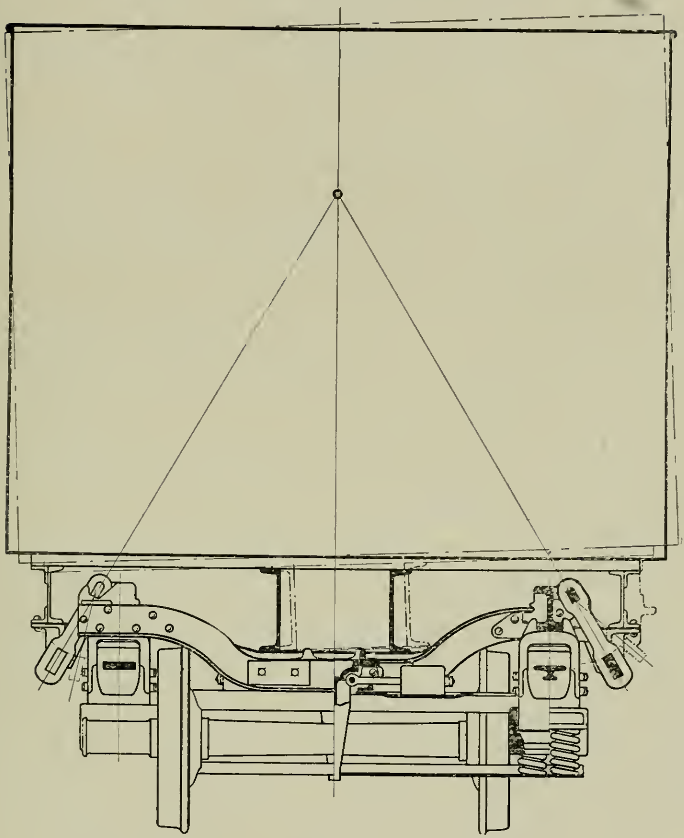

Fig. 5.

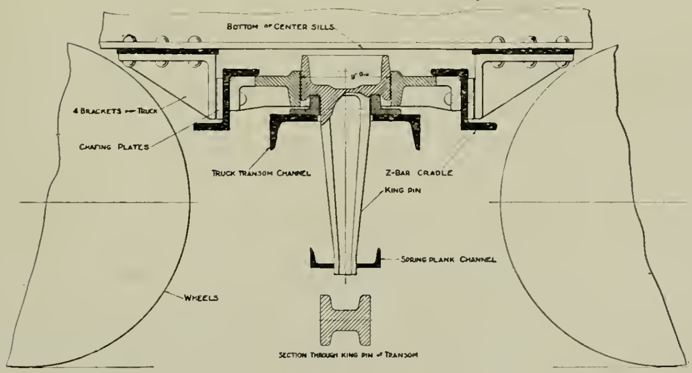
Bottom of Center Sills
4 Brackets per Truck
Chafing Plates
Truck Transom Channel
Z-Bar Cradle
King Pin
Spring Plank Channel
Wheels
Section through King Pin & Transom

Fig. 6.

Second—With one truck on the level and the other on twisted track or super-elevated rail, as when going from straight track to a curve or vice versa, the end out of level will adjust itself, the car body moving downward and inward with relation to the curve. The other truck on the level track will, in a similar manner, effect the equalization of the load. When considering the mechanical points of this inclined hanger arrangement, it should be borne in mind that the lower ends of the hangers on each truck are virtually connected together through the car body, and hangers will move one way or the other in unison, responding to whatever gravity or centrifugal forces that may exist until the horizontal components for each opposite pair of hangers are equal and thus balanced.

Third—When rounding curves the segmental rollers come into play in conjunction with the balancing feature, and the car body will assume an inclination commensurate with the speed and super-elevation, if any, on the curve; and similarly for a stop or lower than calculated speed about a given curve, the top of the car body will swing outward and the bottom inward, thus equalizing whatever centrifugal or gravity forces there may be. This effect is due to the fact that the center of gravity is always a considerable distance below the virtual center of motion formed by the junction of radial components through the center of inclined hangers. (See Fig. 5.)

Fourth—The trucks equalize in unison, each taking its proper share of the abnormal conditions that may exist. If designed to take care of 4″ of vertical motion, a pair of these trucks will absorb a maximum of 8″ of twist in a car length of track without transmitting such stresses into the car body.

Fifth—For any car body of rigid construction, such as all-steel passenger, hopper, gondola or box cars, this truck will effect an equalization of the load on the axles and wheels under the most abnormal track conditions.

Sixth—For any car body, stresses due to rigid center-bearing trucks are reduced to the minimum; thus for refrigerator or tank cars, where air or water-tight construction is imperative, this feature is invaluable, in that the car body is relieved of twists and distortions imposed by the alternate contacting of the side-bearings on the opposite corners in the trucks of the car. The junction of the side frames with the truck cross beams presents a construction of extreme rigidity. A 12″ I-beam is split to 20″ at its ends, where it connects to the top of the column posts, and a 7″ channel spring plank forms the tie at the bottom, an effective cross-tying, insuring permanency in squareness of the truck structure. On the I-beam transom on each side of the king-pin, transversely and connected with it, is placed a helical spring, encased. These springs come into play on curves, relieving the leading wheel of the concentrated effect of a swerving load, and thus distributing it over a much greater rail length and area.

As may be noted from the illustration, chafing plates on the cradle are set low purposely to bring them down into line with the pull. Similar plates on each side of the cradle are provided on the car body. The brake-beam hangers are made of forged steel and the hanger brackets are placed directly on the I-beam transom and are riveted to it.

The trucking of cars with these trucks is as easily accomplished as with the center-bearing truck, it being necessary only to hold the hangers in their inclined position while letting the car body into place.

The side-bearing rockers (Fig. 1) of so large a diameter-equivalent are, of course, very effective in reducing wheel flange and rail friction about curves. With all four side-bearings on the car body always in contact, the pounding and grinding due to the intermittent contacting of friction or anti-friction side-bearings is eliminated. Carrying the load on rockers rotating in machined surfaces, thoroughly oiled, on a rolling contact where they engage with the load, should reduce the friction to the minimum as compared with the non-lubricated center-plate support.

A modification of the truck is shown in Fig. 5, designed for 140,000 lbs. locomotive tender load with 6″x11″ journals. The transom in this case is made of a 15″ channel beam and the cradle is constructed of 6″ Z-bars, so as to pass under the center or draft sills, avoiding modification of this part of the car structure from that in general use with the old center-plate construction.

In this latter truck the king-pin construction has been somewhat modified, the principal aim having been to reduce as much as possible the leverage on the king pin and adjoining parts resulting from the forces imparted to them. It will be apparent from Fig. 6, this being the longitudinal section through these parts, that this construction now approaches the present center-bearing condition in that the cradle-bearing, for the loaded car, overlaps the transom guide, thus placing these parts in direct shear.

PRESIDENT: Mr. Summers will be glad to answer any questions which you may care to ask him, and he also invites criticism. We would like to hear from any of you who have anything to say.

MR. J. KRAUSE: I would not like to discourage the speaker—that would not be proper. I remember once when George Westinghouse came around one night about 11 o'clock with an air brake which was going to do wonderful things, but which I thought was no good. I did not know much about air brakes, but my partner thought he did and he said Westinghouse had air brakes on the brain. I found out afterwards that I was mistaken, and so did he; so it might be, today, that Mr. Summers might have something good.

That rocking arrangement is a fine thing. When you are going 45 mile an hour (that is all we are allowed to run around a 15 degree curve with 7″ elevation of the outer rail), we found once with something similar to this, that it took a car length or more before it would adjust itself. Since we run trains of, say, 5,000 tons, I am afraid this king pin Mr. Summers is depending on, would not keep that body on the track.

I will say again that I do not profess to understand very much about this car, because the pictures are not very plain for my old eyes, but I am like the man from Missouri, I would like to see the thing tried.

PRESIDENT: Mr. Summers, would you reply to that?

MR. SUMMERS: I do not quite understand Mr. Krause's remarks about the size of the king pin. The illustration on the wall marked Fig. 6 is one-half size, and the king pin, full size, is the equivalent of an ordinary center-plate.

With regard to it not getting back to place again or adjusting itself, I have had no complaints concerning the car which has been in service continuously and has been across the continent, from ocean to ocean and return, under load. There is no swinging or swaying in that car such as in the ordinary center-bearing car. In fact, we find very little side sway at the top of the car. It adjusts itself to the track conditions whether running rapidly or slowly. If the car is going as slow as a man walks and you follow it along over a rough track you can see the bottom of the car body move back and forth, transversely of the track, adjusting itself instantly with each irregularity of the track. We have ridden with it going rapidly and the motion is nothing like the motion of a center-bearing truck.

MR. KRAUSE: Just a few words more. I have no doubt that you have tested cars going along. If they speed around curves of say 15 degrees, and you take a glass of water and place it on the car floor, when you reach 45 miles an hour and your outside rail is at an elevation of 7″ over the inside one, the water is running toward the high rail, and, therefore, I say again, the rocking business has got to perform its work very quickly. In flying around the curve, that momentum wanting to go right straight ahead brings the whole car up.

MR. SUMMERS: If I understand Mr. Krause, the glass of water is on the floor of the car, and notwithstanding the outside rail is raised, the water runs toward the high side of the track? Is that correct?

MR. KRAUSE: It runs up to the high rail; yes, sir.

MR. SUMMERS: The center of gravity of the car is somewhere below the intersection of the lines passing up through the center of the inclined hanger bars (See Fig. 5), and the car acts similar to this stick (illustrating, swinging the lower end of a stick suspended from the fingers) swinging around a curve. You will notice the lower end of this stick swings out. Instead of the top of the car body tilting outward the top swings in with the same effect as that produced by the super-elevation of the rail, and in addition to the super-elevation of the rail, the tendency would be to swing in further if the speed was fast enough to cause it. It is quite contrary to any other form of construction that I know of. Ordinarily the centrifugal force throws the top of the car body outward and the car drops down on the outside, whereas, under this construction, it reverses itself.

MR. KRAUSE: There is certainly somebody here that can say something. I would like to hear some more discussion.

MR. G. C. WALTHER: Do I understand that this truck will overcome the action of the centrifugal force? You have the centrifugal force carrying up on the high side of the curve.

MR. SUMMERS: The car body swings; the bottom of it outward and the top onward, due to centrifugal force, but we do not overcome centrifugal force.

MR. WALTHER: You still have the centrifugal force?

MR. SUMMERS: Yes. We do not overcome centrifugal force. If the car goes too slow it might accentuate the difference, it might bring the top of the car a little more outside than the super-elevation of the rail would give.

MR. A. STUCKI: There seems to be a difference of opinion as to whether water in the glass would rise to the outside or not. This is simply a question of speed. If the latter is great enough the water will certainly rise in the glass on the outside, at one certain speed it will remain parallel with the edge of the glass, and as the car slows down, it will approach the edge on the inside.

In regard to the car turning over, I do not think we need to fear anything of that sort, because we had exactly that same condition in the swing motion truck in the beginning of the 90's. At that time nearly every railroad club and every technical paper discussed that very question, i. e., the relative advantage of the swing motion truck and the rigid one. The same condition exists also in many engine trucks today, and it looks to me as though if we did not turn over on those swing motion trucks, we would not have anything to fear here. It is exactly the same motion. When you swing to one side, one hanger bearing rises and the other one drops.

Since I am up, I wish to make a few other remarks which

I noted down while Mr. Summers read the paper. To begin with, I want to say that Mr. Summers deserves a great deal of credit for having the courage to make that step, because it is a big one. We all know that there are people who believe in doing things as their grandfathers did, and if they succeed in this, think they are doing pretty well. Then, again, there are people who try to adapt themselves to new surroundings, who try to better conditions, get up labor-saving devices, etc., in other words, keep pace with the times, or even try to be a little ahead. I do not need to tell you that Mr. Summers does things differently from our grandfathers. His main object, if I understand it, is to save wheel flanges, to save rails, to save power, and last, but not least, to get a steadier riding car.

He has mentioned that ⅜" side-bearing clearance is our standard now, and that is the very reason why our cars resemble rocking boats, even on a straight track. Such continual pounding must in itself be very destructive.

Another point especially interested me. Mr. Summers mentioned sleeping cars on which the side-bearings lock and cause great noise. I have often observed the same thing in my travels. The trouble is caused by the roller being allowed to roll whenever it pleases, and when the body bolster comes down and swings around, the roller is caught in the swing place and has to slide. This shows how important it is to control the roller so that it is always in the proper position and ready to roll whenever the body bolster comes down upon it.

I was going to ask Mr. Summers whether he has any data showing whether it is absolutely necessary to let the king pin slide laterally and bring it back by springs. What would be the consequence if you had a rigid center pin? Of course I understand that in striking a curve you have a more abrupt deflection of the truck, but I would like to know whether you have made any experiments in that way to show whether it is imperative to have a lateral motion there?

MR. SUMMERS: I have no figures on that, but one of the best illustrations I can think of in that connection is that of walking through a dark room in the night-time and suddenly stop your head against the edge of a door. Your head stops abruptly and you realize what impact is. You might run against a pillow or cushion or something of that character and the stop is just as positive, but you give the blow a little more time to stop in. This illustrates to us quicker than anything else what impact is, and, when striking a curve with 140,000 to 150,000 pounds of load on the car, moving with a high velocity along the track, such mass must be arrested at once and its direction changed. There are rough places in the track, also, that change the direction of the car and if you can distribute that stopping of the mass through a little longer time, the result is as marked as the distribution of the force stopping your head. I might say that the transverse spring action between the cradle and the truck transom has a two-fold action. Besides giving the lateral resiliency acting when a more sustained side thrust is brought to bear upon the truck, the springs respond in conjunction with the side-bearing rockers and the inclined hangers for the more rapid oscillations that are set up on poor track under high speed without transmitting these vibrations into the car body.

MR. D. M. HOWE: Speaking about walking through a dark room and coming in contact with different objects, I would like to ask the speaker if he ever came in contact with a rocking chair and fought with it?

MR. SUMMERS: I have a farm up in the country and one night, not long ago, when putting my automobile away, in the darkness, on going out of the barn I ran across a spring-tooth harrow upside down. It had a rocking chair skinned a mile and it had me skinned, too.

A VOICE: Would not a three-point suspension in the truck accomplish the same thing as your four-point suspension with inclined hangers?

MR. SUMMERS: The three-point suspension will not do the same thing. In going around a curve or on a twisted track it would leave one end of the car exactly as it is now, riding on rigid side bearings, one truck taking all of the overturning stress; while with the four-point suspension, that is, suspension on two inclined hangers at one end and two at the other, it adjusts itself the same as a boat in water and permits the car body to swing outward at the bottom and inward at the top when rounding a curve at high velocity, or in going around such curve at a low velocity it will permit it to settle down into a vertical position. That you could not do with a three-point suspension.

A VOICE: I am interested in the subject of flange wear. I would like to know how much Mr. Summers expects to get from his truck. The best example of long flange wear I ever saw was on a car on the South Side, near Smithfield street. It had iron wheels under it, and ran nine years and there was no sign of flange wear at all. If that is 100%, I would like to know what Mr. Summers could get with his truck. Also, whether he has made any experiments bucking the car down from a hump on a curve to run into other cars with ordinary trucks.

MR. SUMMERS: With regard to better flange wear, all I know is that we can carry the car with a load on all four bearings *all the time,* and, in so doing, we distribute the load over all eight wheels on the car, while with the center-bearing on a twisted track where you have the load up on one side bearing, which is approximately in line with one pair of wheels in the truck, you carry the entire load at one end of the car, on one pair of wheels, which increases the load approximately 100% on one end of the car.

There is, up to this time, only one car of this type in use. It has been in service something over a year. I have not followed it up to see where it went, but it has taken care of itself and we have had no replacements of anything, excepting some flat wheels from skidding and some brakeshoes. I think also I got a bill for an air hose. Outside of that, there has been no replacements at all. The car has been loaded with 100% loads approximately all the time and it has taken its place with and among other cars and taken everything that other cars get. I will admit that one car is not very much of a showing. It will take the combined results of a good many cars to show what it will do. This, I think, too, applies to the one car that you speak of, since the results from railroads that keep track of flange wear show great variations. I know of some experience that was given to me by a General Superintendent of Motive Power on one of the big lines, where he stated, in effect, that their wheel flange wear was 100% greater on cars of 50 tons capacity than on cars of 25 tons capacity; in other words, that wheels fail in half the time from flange wear on the 50-ton cars, notwithstanding the attempts that have been made to increase the wheel in proportion to the tonnage of the car. There are other instances I have heard of where flange wear was a great deal greater, so that the isolated one car that the assumed 100% is like this one car of mine—it shows no flange wear.

I do not base my claims on saving in flange wear alone on this truck, but I do claim that a car carrying the load divided on both sides and adjusted so that it can swing into position, in a manner similar to a boat floating in water, has a much better chance for maintaining its structure throughout its life, or, in other words, increasing the life of that car by reason of not having the load alternately carried on one corner and then on the other corner of the car. It saves the body, it saves the roof, it saves the truck, it saves the wheels and it saves the track, and, by eliminating rigidity, makes it possible for an engine to pull more cars.

It takes nerve for a railway official to recommend any radical departure from the standard types of designs in use. It has cost me a little something to go this far with the trial car, but I know I am on the right track. I am doing my part as far as I can toward determining just how much saving there is, and I feel sure that the railroad people or the car users will give it a trial on a larger scale as fast as they learn of its true value.

MR. KRAUSE: You speak of 50-ton cars and wheels wearing out. Of course, you have not told us what mileage your car has made. To the coast and back would be 6,000 miles only. We find, since we have adopted 50-ton cars, 30,000 miles will wear out cast iron wheels. Not the flange, in many cases, but the tread is gone. When we had 25 or 30-ton cars we found that we could get 60,000 miles out of our cast iron wheels on an average. When you are playing with 50-ton cars at the speed we are running now, at 80% and 100% air, when an air hose bursts, then things take place, you know. I admit your courage in getting this thing up and trying it out. I have tried so many things that I like to see a fellow win.

MR. SUMMERS: I believe things do take place. I will say this with regard to wheel flange wear: I am not making any claims that this car has shown anything with regard to wheel-flange wear. I do claim that it does a great many other things for a car, and if there is any saving in wheel flange wear we will throw that in gratis.

With regard to things taking place, I remember back about 30 years, I was a railroad man then myself; was out along the right-of-way building bridges. With a number of others I was one day taking a stringer from a small span and replacing it. There was a freight train due to come down the track and we had a man to keep it from coming on us until we could get the new stringer in place. We had the stringer back under the ties, but not quite in position, were holding it up to put some shims in place, when the freight hove in sight down the hill. They did not stop for the flag-man, though he threw stones at the engineer. They kept on coming, and I with some others were down under the bridge with our shoulders lifting up on the stringer trying to get it fixed in time to let the train across, until finally we decided that we could not stay there longer, and we ran out into a corn field. I saw a brakeman, running along the train, drop down on his back, grabbing the running-board with both hands. The engineer got over the bridge before the stringer gave way. Then things began to happen. The car with the man riding on his back on the running-board came over into the corn field pretty near where I was standing. He swung his feet out and jumped off, running from it as the car settled down, and said: "I've rode them before"! (Applause.)

MR. STUCKI: There is hardly anything new under the sun when you come down to real facts. If I understand this construction rightly, it consists of three specific items; one is the hanger suspension, the other is the principle of carrying the weight at the sides, and the third is the feature of doing away with the friction between truck and the car in curving. Each one of these principles has been used and tried out in railroading years ago. The swinging motion truck is possibly as old as railroading itself. The load has been carried out on the sides before, and a good many of you undoubtedly know that a great many of the earlier electric trucks carry the load that way, and you also know that the friction between truck and car is now being relieved in various ways. There you have the three principles, and

Mr. Summers has only combined them in his construction. It is true, however, that the cradle construction used as an intermediate member between car and truck, is novel and new and has not been used before, to my knowledge, and by its use it has been made possible to carry the load on all four points, a feature very prominent in this truck.

MR. J. D. CONWAY: Mr. President, I take it as we do not hear any more discussion, that they are all through. It was not my purpose to get up to offer sympathy to Mr. Summers for trying to knock the teeth out of that harrow in the dark, but I do want to say just a word to recall, perhaps, circumstances that took place before this Club some years ago. I am sure I see a great many faces in this room that were present at a meeting when Mr. Summers read a paper advocating cars without center sills. It seemed to be such a radical step in car construction that it left him practically without support. We all recall that railroad men on that occasion did not agree with his proposition. The result of Mr. Summers' success is convincing in view of the fact that some thousands of his type of cars are in service on the railroads today. He now advances another step in the way of a swing motion truck, and I do not believe that any of us would care to say that this type of truck is either fanciful or a product presented without careful consideration of service requirements. The subject is quite interesting, the paper extremely so to the mechanical men on railroads. They have been working on many styles or types of center-plates and side-bearings and it may be Mr. Summers has more or less opened the road to something nearer perfection along that line than we have at this time.

MR. STUCKI: I was in hearty accord with the remarks of Mr. Conway until he touched a subject foreign to the subject of this paper, namely, the question of cars without center-sills, and, judging from what he said, a car without center-sills is now accepted by the railroads. This is not the case, and Mr. Conway must have been misinformed. Even Mr. Summers will agree to this, as he, since said meeting, has never built a single car as contested that night, and there is not a single railroad which has, and I, for one, believe now, as I did then, that the railroads are correct in continuing the use of center-sills. The ore car and gravity dump car, with which Mr. Summers made a great success, required, as all other ore cars do, a large opening in the center, which made the use of center-sills impossible, requiring special bracing and stiffening, which, on ordinary cars, would be out of question. Hence, we will continue to use center-sills.

MR. CONWAY: We have listened to a most interesting paper and I think it both fitting and proper that a vote of thanks be extended to Mr. Summers from this Club, and I will offer such a motion.

The motion was duly seconded and carried by unanimous vote.

PRESIDENT: Mr. Summers, accept the thanks of the Club.

Is the Committee on Nominations ready to report?

MR. HOWE: Mr. President, your Committee on Nominations beg leave to submit the following report. We respectfully submit the following list of nominations for officers to serve for the ensuing year:

PRESIDENT
F. R. McFeatters.

FIRST VICE PRESIDENT
A. G. Mitchell.

SECOND VICE PRESIDENT
J. T. Carroll.

TREASURER
J. D. McIlwain.

SECRETARY
(One to elect)
J. B. Anderson,
W. W. Griswold,
H. V. Porter.

EXECUTIVE COMMITTEE
(Three to elect)
L. H. Turner,
F. H. Stark,
D. J. Redding.

FINANCE COMMITTEE

(Three to elect)
D. C. Noble,
Stephen C. Mason,
C. E. Postlethwaite.

MEMBERSHIP COMMITTEE

(Five to elect)
D. M. HOWE,
A. W. Crouch,
F. M. McNulty,
M. A. Malloy,
A. Stucki.

PRESIDENT: A letter ballot will be sent out for this election and report made by the Election Committee at the next meeting.

ON MOTION of Mr. J. D. Conway the report of the Nominating Committee is accepted.

ON MOTION, Adjourned.

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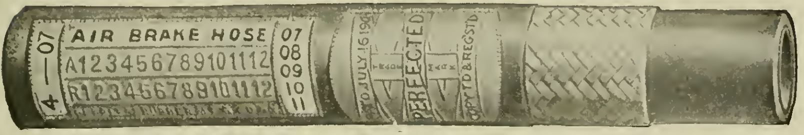

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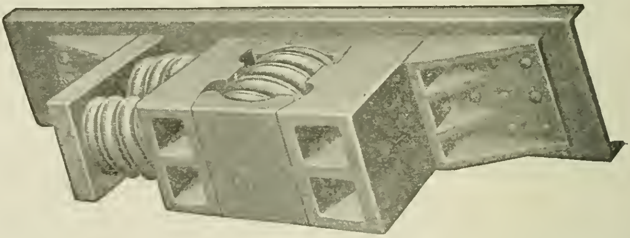

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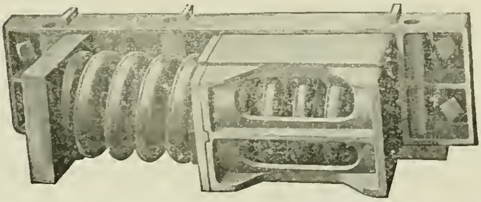

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Annual Meeting, Election of Officers—Smoker

Constitution, By-Laws and Names of Members

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*No. 4

What the Actual User Says About the Steel Boiler Tube

The Fifth Annual Convention MASTER BOILER MAKERS' ASSOCIATION was held at the Rome Hotel, Omaha, Nebr., May 23, 24, 25, 26, 1911.

The Committee previously appointed reported on the subject of **"Steel vs. Iron Flue. What Advantage and What Success in Welding Them and the Effect of Tube and Maintenance."**

Considerable interesting discussion ensued.

For example: The Foreman Boiler Maker of a large railroad in the middle West reported as follows: (THE BOILER MAKER, June, 1911, page 618)

> (Mr. ——) "In No. 202 passenger engine, the flues were removed on account of machinery principally; the engine had made 103,000 miles I believe. I had steel flues on the right side and iron flues on left. I took the steel flues out of the boiler first, then removed the left side. I applied the rattler in the same way to each. Six steel flues pitted so that they had to be thrown away, and on the iron side there was forty-nine thrown away. No. 202 was running on the Eastern Division. On the Western Division we had an engine with steel and iron flues. The iron flues gave us, as far as pitting is concerned, better results than the steel, but in general our steel flues give us the best service. I took particular pains to get this information because I was chairman of this committee, and I wanted to get all the details in regard to the use of the engines. I went into the firebox myself before the flues were taken out to thoroughly examine the beads. I found that the steel flues retained their strength better than the iron flues. On the western end of our road, the Wyoming Division, I had a man who gave particular attention to it, and his report to me was that the left-hand side—the iron side—leaked more than the right steel side. We had good success with our iron flues in certain water, and in other waters our steel tubes gave the best results. We had less pitting in some districts with the steel and just the reverse in other districts. These conditions were brought about by the water.
>
> (A Member) "Do you use steel safe ends or iron ends?"
>
> (Mr. ——.) "Both: on our large and heavy power we use steel. We use iron flues and body flues—the 16-inch flue—cut for 14-foot boiler. We cut them up for use on our smaller power, but on our larger power we use steel ends. Those I mentioned were entirely new flues."
>
> (A Member). "There were fourteen steel against forty-six iron. I think I have the record on that, and there was only nine thrown away."
>
> (A Member). "Why do you use steel on your large power?"
>
> (Mr. ——.) "In one sense we get better service in the fire box end, and our general orders from Chicago headquarters are to that effect."

Please note from the above that Steel Tubes are used on the large power where the service is severe; in other words, the Steel Tube has the preference where conditions are exacting.

Many Motive Power Departments are searching for methods to reduce their expense.

The Steel Boiler Tube represents a triple economy as follows:

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(2) Saving in maintenance expense. (See April, 1911, issue.)
(3) Greater Mileage—less cost per mile (See April, May and September issues.

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*This is the fourth of a series of announcements containing an opinion of an actual user of the Steel Boiler Tube.

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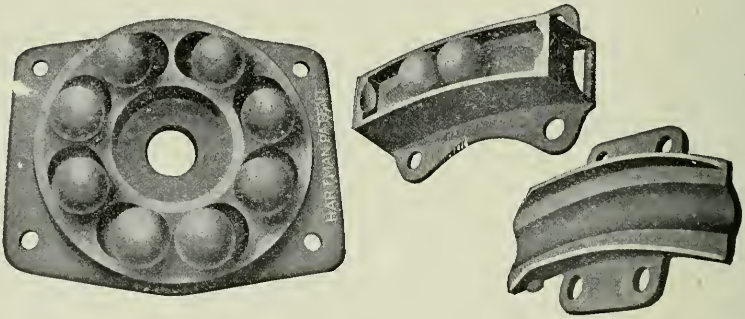

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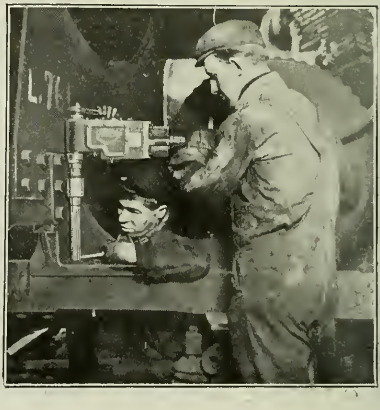

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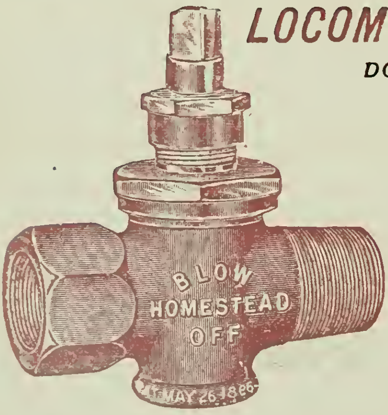

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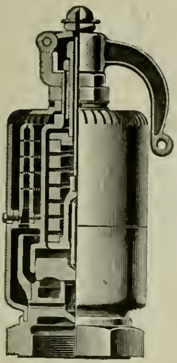

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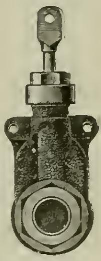

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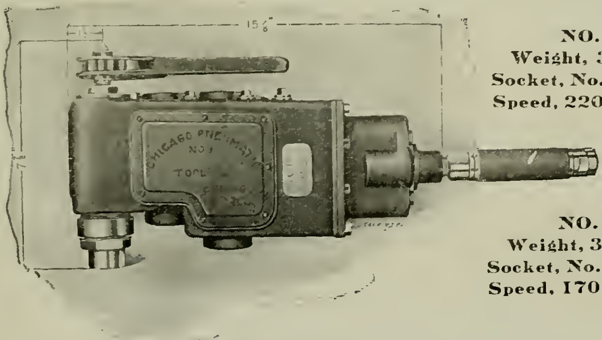

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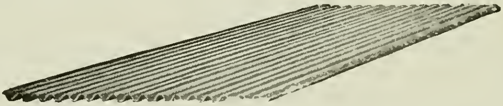

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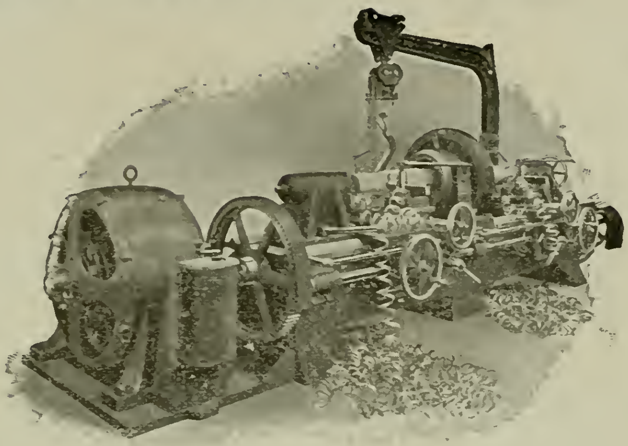

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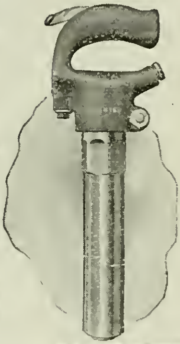

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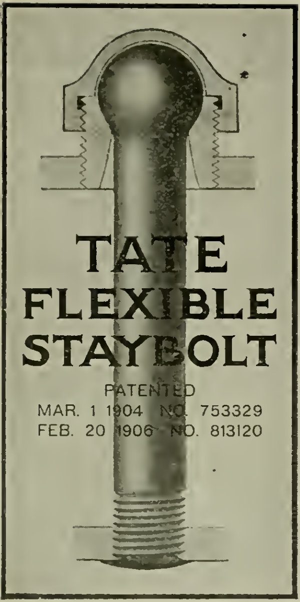

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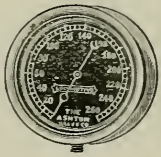

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INDEX—ADVERTISERS.

NAME	Page
American Brake Shoe & Foundry Co	iii
American Locomotive Company	viii
Ashton Valve Co	xi
Ball Chemical Co	v
Brady Brass Co	Front Cover
Butler Drawbar Attachment Co	xviii
Chicago Pneumatic Tool Co	v
Clancy, J. R	xvii
Cleveland City Forge & Iron Company	Front Cover
Crosby Steam Gage & Valve Co	v
Damascus Brake Beam Co	xvii
Dixon, Jos., Crucible Co	vi
Flannery Bolt Co	xi
Fort Pitt Malleable Iron Co	xii
Franklin Manufacturing Co	viii
Galena-Signal Oil Co	xii
Gold Car Heating & Lighting Co	vi
Gould Coupler Co	ii
Gray-Thurber Automatic Train Control and Signal Co. of America	x
Homestead Valve Mfg. Co	iv
Hunt-Spiller Mfg. Co	xi
Independent Pneumatic Tool Co	ii
Ingersoll-Rand Co	x
Lawrenceville Bronze Co	xv
Lino Paint Co	Back Cover
Long, Chas. R. Jr. Co	iii
Magnus Metal Company	vi
Manning, Maxwell & Moore	iii
McConway & Torley Company	xv
Nathan Manufacturing Co	iv
National Car Wheel Co	iii
National Malleable Castings Co	vi
National Tube Co	i
Niles-Bement Pond Co	ix
Peerless Rubber Mfg. Co	xvii
Pittsburgh Coal Co	iv
Pittsburgh Equipment Co	Back Cover
Pittsburgh Testing Laboratory	Front Cover
Pressed Steel Car Co	xx
Railway Steel Spring Co	xvi
Safety Car Heating & Lighting Co.	xvi
Sipe, James B. & Co	Front Cover
Standard Coupler Co	xix
Standard Steel Car Co	xviii
Steel Car Forge Co	Front Cover
Suydam, M. B. Co	Back Cover
Union Spring & Mfg. Co	xiv
Union Steel Casting Co	xix
Ward Equipment Co	xix
Washington Coal & Coke Co	ix
Western Railway Equip. Co.	Front Cover
Westinghouse Air Brake Co	vii
Westinghouse Electric & Mfg. Co.	vii
Westinghouse Machine Co	vii
Wood, Guilford S	Front Cover

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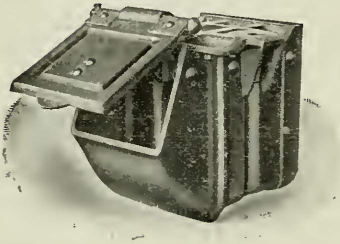

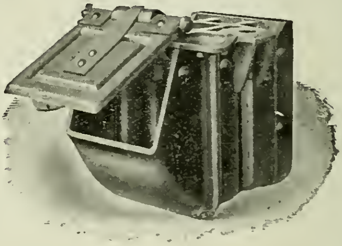

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of the
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ORGANIZED OCTOBER 18, 1901.

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VOL. X. No. 9 — Pittsburgh, Pa., October 27, 1911. — $1.00 Per Year 20c Per Copy

Published monthly, except June, July and August, by the Railway Club of Pittsburgh, C. W. Alleman, Secretary, General Offices P. & L. E. R. R., Pittsburgh, Pa.

Meetings held fourth Friday each month, except June, July and August.

PROCEEDINGS OF ANNUAL MEETING, OCTOBER 27th, 1911.

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock P. M., with President F. R. McFeaters in the chair.

The following gentlemen registered:

MEMBERS.

Alleman, C. W.
Allison, John
Allen, Jas. P.
Anderson, J. B.
Andrews, F. G.
Baldwin, G. C.
Bannister, E. J.
Barth, John W.
Bealor, B. G.
Beatty, E. A.
Bell, W. K.
Beltz, J. D.
Benner, J. W.
Bennett, R. G.
Bihler, L. C.
Binns, J. Y.
Boyer, Chas. E.
Brand, Thos.
Brandt, E. K.
Briggs, I. O.
Brown, A. D.
Brownscombe, G. J.
Buechner, W. A.
Bulkley, B. M.
Burry, V. J.
Carpenter, H. L., Jr.
Chapin, E. S.
Chilcoat, H. E.
Chittenden, A. D.
Chrysler, W. P.
Clark, C. C.
Clark, Homer L.
Clifford, M. J.
Cline, W. A.
Cochran, C. C.
Cole, Jewett
Conway, J. D.
Cook, J. A.
Coulter, A. F.
Crouch, A. W.
Cunningham, R. I.
Dambach, C. O.
DeArment, J. H.
Deckman, E. J.
Dennis, J. G.
Detwiler, U. G.
Dickinson, T. W.
Dorr, C. O.
Drake, Thos. E.
Drake, W. C.
Drane, E. J.
Drayer, U. S.
Dudley, G. W.
Evans, H. E.
Eichenlaub, W. C.
Falkenstein, W. H.
Flaherty, P. J.
Forsythe, G. B.
Foreman, J. E.
Fray, Samuel
Freshwater, T. H.
Gallinger, G. A.
Gearhart, J. A.
Geddes, J. R.
George, M. E.
Gibson, F.
Gies, Geo. E.
Gilg, H. F.
Gillespie, J. M.
Gray, Guy M.
Green, H. W.
Grewe, H. F.
Griswold, W. W.
Grose, J. H.
Guay, John W.
Gulick, H.
Gutierrez, S. J.
Guy, W. A.
Hackenbury, J. H.
Harriman, Henry A.
Hauser, W. M.
Haynes, J. E.
Heady, T. B.
Henderson J. W.
Hepburn, M. J.
Herlehy, Thos. W.

Hickey, A. F.
Hoffman, N. K.
Hollien, W.
Hood, D. G.
Howe, D. M.
Hudson, W. L.
Huyett, E. G.
Jack, C. H.
Jenny, Jacob
Johnson, Carl A.
Johnson, W. A.
Johnson, W. C.
Jordan, J. E.
Kelly, H. B.
Kennedy, Jas.
Keptner, J. B.
Kessler, D. D.
Kewley, E. C.
Kinney, M. A.
Kintner, D. H.
Kirk, T. S.
Koch, F.
Kleinhaus, H.
Klingensmith, W. H.
Knight, E. A.
Kurzhals, C. L.
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Miller, F. L.
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Oates, G. M.
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Orchard, Chas.
Orner, Milton T. S.
Osmund, C. M.
Parry, W. I.
Peacock, W. H.
Pechstein, A. J. G.
Peters, W. P.
Pfeil, John
Phelps, W. H., Jr.
Phillips, Lee
Pickels, H. D.
Porter, H. V.
Postlethwaite, C. E.
Publow, John J.
Quest, W. O.
Rabold, Wm. E.
Raser, Geo. B.
Rea, C. S.
Redding, D. J.
Reese, F. T.
Richardson, C. A.
Rinehart, H. W.
Robertson, Jas. D.
Robinson, S. R.
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Schauer, A. J.
Scheck, H. G.

Schoonover, W. H.
Schreiner, W. C.
Schultz, Geo. H.
Shook, S. D.
Shuck, W. C.
Shumaker, F. A.
Smith, A. D.
Smith, Geo. H.
Smith, Russell
Snyder, Jos.
Stafford, Samuel G.
Stem, L. H.
Stewart, S. R. B.
Stoddart, W. G.
Stucki, A.
Suckfield, G. A.
Trout, W. L.
Tucker, J. L.
Von Schlick, H. H.
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Warne, J. C.
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Wendt, E. F.
Wescoe, F. B.
White, J. D.
White, F. L.
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Wiseman, E. B.
Wood, Ralph C.
Woodings, E.
Woodworth, R. B.
Zinmaster, F.

VISITORS.

Abell, Van J.
Aldcorn, Thos.
Alleman, J. C.
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Blakey, R. O.
Bolig, R. S.
Brunner, W. F.
Campbell, H. E.
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Jones, J. F.
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Mooney, J. A.
Morris, H. W.
Myers, C. A.
McCollum, G. C.
McKee, C. M.
McKelvie, J. W.
McNamara, T. L.
Nelan, E. J.
Norris, W. B.

O'Brien, W. P.
Oester, Geo.
Oldham, C. G.
Pascoult, C. O.
Pechstein, T. M.
Platt, A. T.
Ramsdell, F. E.
Rauck, J. M.
Rebstock, J. B.
Rebhun, C. F.
Reed, W. S.
Remmel, W. H.
Reynolds, D. E.
Rhodes, R. W.
Rowe, M. L.
Runser, K. W.
Sayre, H. A.
Schaub, T. J.
Schanwecker, C. L.
Schindelutte, H. F.
Seely, C. A.
Sharp, R. C.
Slato, Geo.
Smith, Chas. P.
Smith, Sion B.
Smith, Josiah
Snyder, Geo. W.
Southwick, E. P.
Streib, J. F.
Thompson, H. H.
Leslie, S. I.
Lewis, D. R.
Linhart, W.
Long, H.
Maguire, E. J.
Tollerton, W. M.
Walter, W. A.
Weidenkoff, T. J., Jr.
Willoughby, D. J.
Yohe, Curtis M.

The reading of the minutes of the last meeting was dispensed with, the same being in the hands of the printer.

The Secretary read the following list of applications for membership:

Backowski, Jos. G., Stenographer, American Spiral Spring & Mfg. Co., Fifty-eighth and Butler Sts., Pittsburgh, Pa. Proposed by R. E. L. Bailey.

Bailey, H. H., Yardmaster, Monongahela Division P. R. R. Co., 509 W. Main St., Monongahela, Pa. Proposed by R. J. Doyle.

Barney, Henry E., Secretary and Treasurer, Laughlin-Barney Machinery Co., Union Bank Bldg., Pittsburgh, Pa. Proposed by C. W. Alleman.

Battinhouse, John, Inspector, Westinghouse Air Brake Co., No. 670-A Middle Ave., Wilmerding, Pa. Proposed by Pierre L. Lobez.

Bleasdale, James, Supervisor Air Brakes, B. & O. R. R., No. 526 Wallace Ave., Wilkinsburg, Pa. Proposed by R. I. Cunningham.

Briggs, Templeton, Assistant Chief Inspector, Carnegie Steel Co., Schoen Steel Wheel Works, McKees Rocks, Pa. Proposed by Frank J. Black.

Burke, William, Assistant Yardmaster, Monon. Conn. R. R., 405 Oakland Ave., Pittsburgh, Pa. Proposed by Frank McCune.

Christfield, J. C., Mechanical Engineer, Forged Steel Wheel Co., Butler, Pa. Proposed by A. Stucki.

Dunham, T. P., Rep. Garlock Packing Co., 604 Arch St., Philadelphia, Pa. Proposed by A. Stucki.

Garaghty, W. C., Road Foreman of Engines, B. & O. R. R., Newark, O. Proposed by A. W. Crouch.

Hilty, H. A., Foreman Car Repairs, P. R. R., 171 Mayflower St., Pittsburgh, Pa. Proposed by W. H. Sullivan.

Johnson, J. E., Manager, Garlock Packing Co., Pittsburgh, Pa. Proposed by A. Stucki.

Jones, Julian D., Asst. Div. Operator, P. R. R., Room 302, Union Station, Pittsburgh, Pa. Proposed by J. B. Anderson.

Lane, E. G., Engineer M. of W., B. & O. R. R., Water St. Station, Pittsburgh, Pa. Proposed by W. W. Griswold.

Lang, W. C., Asst. Genl. Foreman Car Shops, P. & L. E. R. R., 719 George St., Coraopolis, Pa. Proposed by Samuel Lynn.

Lewis, O. M., Genl. Yardmaster, Wabash-Pittsburgh Terminal Ry., 1304 Methyl St., Pittsburgh, Pa. Proposed by C. O. Dambach.

Lewis, T. L., Salesman, The Fairbanks Co., Pittsburgh, Pa. Proposed by W. W. Griswold.

Little, J. S., Asst. Road Foreman of Engines, B. & O. R. R., Newark, O. Proposed by A. W. Crouch.

Mackert, A. A., Chief Inspector, W. A. B. Co., 450 Caldwell Ave., Wilmerding, Pa. Proposed by Pierre L. Lobez.

Maxfield, H. H., Master Mechanic, Penna. R. R. Co., Twenty-eighth St., Pittsburgh, Pa. Proposed by J. B. Anderson.

Montague, W. T., M. P. Inspector, Penna. R. R. Co., Room 207, Union Station, Pittsburgh, Pa. Proposed by J. B. Anderson.

Mooney, J. A., Storekeeper, W.-P. T. Co., Rook, Pa. Proposed by W. K. Krepps.

Mowry, A. T., Asst. Enginehouse Foreman, Penna. R. R. Co., Alter St., Wall, Pa. Proposed by W. H. Sullivan.

Newbury, E. H., Asst. Master Mechanic, Penna. R. R. Co., Thirty-second and Carsons Sts., Pittsburgh, Pa. Proposed by M. A. Malloy.

O'Brien, W., Road Master, Wabash-Pittsburgh Terminal Ry., Wabash Bldg., Pittsburgh, Pa. Proposed by C. O. Dambach.

Peter, Phillip, Manager Sales, Central Ry. Signal Co., 509 Columbia Bank Bldg., Pittsburgh, Pa. Proposed by C. W. Alleman.

Rennie, Geo. J., Asst. Supt., Carnegie Steel Co., 204 Western Ave., Aspinwall, Pa. Proposed by F. L. White.

Richardson, S. W., Yardmaster, Penna. R. R. Co., P. O. Box 52, Courtney, Pa. Proposed by R. J. Doyle.

Schiller, John, Traveling Conductor, Wabash-Pittsburgh Terminal Ry., Wabash Bldg., Pittsburgh, Pa. Proposed by C. O. Dambach.

Scheming, Geo., Foreman, Smith Shop, Penna. R. R. Co., 529 Lobinger Ave., Braddock, Pa. Proposed by W. H. Sullivan.

Silk, Edward E., Sales Agent, Bettendorf Axle Co., 1510 McCormick Bldg., Chicago, Ill. Proposed by W. W. Griswold.

Soulsby, Jos., Yardmaster, Penna. R. R. Co., 438 Railroad St., Monongahela, Pa. Proposed by R. J. Doyle.

Stewart, William, Master Mechanic, Carnegie Steel Co., 1844 Morningside Ave., Pittsburgh, Pa. Proposed by F. L. White.

Streett, O. B., Chief Clerk, B. & O. R. R., 1008 House Bldg., Pittsburgh, Pa. Proposed by J. D. McIlwain.

Truax, William E., Yardmaster, Penna. R. R. Co., Elrama, Pa. Proposed by R. J. Doyle.

Wilson, R. S., Car Distributor, Union R. R. Co., 218 Camp Ave., Braddock, Pa. Proposed by Frank Gibson.

Winters, H. G., Yardmaster, Penna. R. R. Co., Elrama, Pa. Proposed by R. J. Doyle.

PRESIDENT: When these applications have been approved by the Executive Committee, the gentlemen will become members.

SECRETARY: It is with much regret that we announce the death of two of our members, Julius Krause, General Car Inspector, Pennsylvania Railroad, who died October 7th, 1911, and L. S. Klein, Treasurer, American Car Screen Company, who died October 2nd, 1911. We received word of Mr. Krause's death in time to send a floral tribute from the Club, and we have received a card of acknowledgment from the family.

PRESIDENT: I will appoint as committees to draw up suitable memorials for our minutes, the following members: On the death of Julius Krause, Mr. D. J. Redding, Mr. D. M. Howe and Mr. M. A. Malloy. On the death of L. S. Klein, Mr. J. D. Conway, Mr. Wm. P. McGraw and Mr. R. Evans.

PRESIDENT: We will now listen to the annual reports of the Secretary and Treasurer.

SECRETARY'S REPORT.

To the Officers and Members of the Railway Club of Pittsburgh:

Gentlemen: I am pleased to submit below statement of the events closing the tenth anniversary of our organization and desire to thank the officers and members for the many kindly acts and courtesies extended me during the three years that I have served as your Secretary.

The business depression during the past year has to no great extent lessened the support given us by our advertisers in the Proceedings, and their loyalty is very much appreciated.

Death removed from our midst during the year the following members: G. P. Sweeley, L. S. Klein, Julius Krause.

The following is a summary of the membership, financial condition, etc., for the year up to and including this meeting:

MEMBERSHIP.

Reported last year	752	
Received into membership during year	226	
Reinstated	2	
		980
Suspended, non-payment of dues	76	
Resigned	24	
Loss of address	8	
Removed by death	3	
		111
Present membership		869

FINANCIAL.

Receipts—

In hands of Treasurer last year	$1,769 26	
From advertising	1,737 75	
From dues	2,541 00	
From sale of Proceedings and other sources	435 84	
		$6,483 85

Disbursements—

Printing Proceedings, advance sheets, notices etc.	$1,887 27
Hotel, lunch, etc.	578 85
Postage for Journals, etc.	413 57
Secretary's trip to Atlantic City	50 00
Cigars for meetings	146 25
Stereopticon light	30 00
Stationery and supplies	90 50
Messenger service	37 00
Reporting proceedings	135 00
Entertainment	190 00

Miscellaneous	22 98	
Floral emblems	50 75	
Secretary's salary, year 1910-1911	500 00	
		$4,132 17
Balance in hands of Treasurer		$2,351 68

C. W. Alleman,
Secretary.

Approved:

L. H. Turner,
F. H. Stark,
D. J. Redding,
Executive Committee.

TREASURER'S REPORT.

Pittsburgh, Pa., October 27th, 1911.

Receipts—

Balance on hand from last year	$1,769 26	
Received from Secretary during year	4,714 59	
		$6,483 85

Expenditures—

Paid out on Secretary's checks	$4,132 17
Balance on hand	$2,351 68

Respectfully submitted,

J. D. McIlwain,
Treasurer.

Approved:

L. H. Turner,
F. H. Stark,
D. J. Redding,
Executive Committee.

PRESIDENT: We also have the announcement of the result of the election of officers for the ensuing year, and I will ask the Secretary to read the report.

Mr. President and Gentlemen: In accordance with the Constitution and By-Laws of the Club, the ballots for the election of officers for the ensuing year were sent out by the Secretary in the usual way. There were a total of 554 votes cast, and the following officers were elected for the ensuing year:

President—F. R. McFeatters.

First Vice President—A. G. Mitchell.

Second Vice President—J. T. Carroll.

Treasurer—J. D. McIlwain.

Secretary—J. B. Anderson.

Executive Committee—L. H. Turner, F. H. Stark, D. J. Redding.

Finance Committee—D. C. Noble, Stephen C. Mason, C. E. Postlethwaite.

Membership Committee—D. M. Howe, A. W. Crouch, F. M. McNulty, M. A. Malloy, A. Stucki.

D. J. Redding,
Member Executive Committee.

C. W. Alleman,
Secretary.

Pittsburgh, Pa., October 26th, 1911.

In response to many calls for a speech, the President said:

PRESIDENT: Gentlemen, I do not know that I can say anything about my re-election as I had no opposition. However, I sincerely thank you for the honor. Mr. Mitchell, the newly-elected First Vice President, requested me to allow him to make the address of the evening, and I will now call upon him.

MR. A. G. MITCHELL: Mr. President and Gentlemen: I told the President I would say just what he said and he has said so little that there is hardly any use for me to repeat it, as you all know what he said.

PRESIDENT: We would like to hear from Mr. Anderson, the Secretary-elect.

MR. J. B. ANDERSON: Mr. President and Fellow-Members of the Club: I greatly appreciate the honor of being elected

Secretary of this Club, and assure you that I will put forth my best efforts to promote the interests and maintain the high standard of the Railway Club of Pittsburgh.

PRESIDENT: Mr. Stucki, can we hear from you?

MR. A. STUCKI: Mr. President and Members of the Club: Mr. Howe is not feeling very well this evening. He was out late last night, or perhaps I should say he was prevented from getting home early, so he asked me to take his traditional place on this program. You all know that our worthy Secretary, Mr. Alleman, declined the re-election as Secretary for the ensuing year, on account of the condition of his health and the amount of other work that he is obliged to do. For these reasons he deems it unwise to attempt to serve longer in this capacity. Gentlemen, I need not say that we are all very sorry for this, but we feel that we must respect his wishes, as he knows best what to do, although we feel distinctly disappointed that he felt obliged to decide as he did. I am not going to make a long speech, but I do want to say that I know I voice the sentiment of you all when I make this statement: Mr. Alleman has been a good and faithful Secretary. He has been loyal to the Club and he has been loyal to the members, and I know the very pleasant relations that have existed between us will never be forgotten. Mr. Alleman, we for our part will always remember you as a friendly Secretary, and I have been delegated by Mr. Howe, on behalf of the members of the Club, of all, not a few, to present to you as a remembrance, this small token of their friendship and regard. Mr. Alleman, I present this with the express understanding that the inscription inside means just what it says: "From the Members of the Railway Club of Pittsburgh to our beloved Secretary," and the spirit in which it is given is as sound as the gold the case contains. May you, Mr. Secretary, whenever you see this inscription, think kindly of this Club, may you think kindly of every one of your fellow-members in this Club, and whenever you look upon this inscription may it remind you anew of the warm friendship and high regard and kindly wishes we herewith try to express to you in this, though modest, way.

MR. C. W. ALLEMAN: Gentlemen, you have caught me off my guard. I certainly appreciate what you have done and I really cannot find words to suitably express myself. I assure you that I deeply appreciate this gift from the bottom of my heart, and I will always cherish with the warmest feelings of gratitude the remembrance of your friendship and consideration for me. This is about all I can say at the present time and I hope you will excuse me from making any further remarks.

PRESIDENT: The regular business of the meeting having been completed, we will now proceed to the entertainment.

The following programme was rendered:

1. America .... Orchestra
2. Wilkes' Lady Minstrels.......... "A Minstrel First Part"
3. Baritone Solo .... Selected
Mr. Jas. McKelvie
4. Mysterious Moore .... Magic and Mystery
5. Duet .... Selected
Messrs. McKelvie and Smith
6. Story Teller .... Mr. Frank De Loss
7. Cazaros .... Character Artiste
8. Tenor Solo .... Selected
Mr. Josiah Smith
9. Oppelt .... Ventriloquist
10. Visocchi Brothers ...... Whistling and Organette Virtuosos
11. Alexander's Ragtime Band...... Orchestra and All Present
Music by Todd's Orchestra

After the entertainment the following menu was served to the members of the Club and visitors present:

Consomme Princesse

Radishes Celery

Chicken Pattie, Reine Assorted Sandwiches

Nesselrode Pudding Coffee

Pipes, Tobacco, Stogies, Murad Cigarettes.

The Railway Club of Pittsburgh Constitution.

ARTICLE I.

The name of this organization shall be "The Railway Club of Pittsburgh."

ARTICLE II.

OBJECTS.

The objects of this Club shall be mutual intercourse for the acquirement of knowledge, by reports and discussion, for the improvement of railway operation, construction, maintenance and equipment, and to bring into closer relationship men employed in railway work and kindred interests.

ARTICLE III.

MEMBERSHIP.

Section 1. The membership of this Club shall consist of persons interested in any department of railway service or kindred interests, or persons recommended by the Executive Committee upon the payment of the annual dues for the current year.

Sec. 2. Persons may become honorary members of this Club by a unanimous vote of all members present at any of its regular meetings, and shall be entitled to all the privileges of membership and not be subject to the payment of dues or assessments.

ARTICLE IV.

OFFICERS.

The officers of this Club shall consist of a President, First Vice President, Second Vice President, Secretary, Treasurer, Finance Committee consisting of three members, Membership Committee consisting of five members, and three Elective Executive Members who shall serve a term of one year from the date of their election, unless a vacancy occurs, in which case a successor shall be elected to fill the unexpired term.

ARTICLE V.

DUTIES OF OFFICERS.

Sec. 1. The President shall preside at all regular or special meetings of the Club and perform all duties pertaining to a presiding officer: also serve as a member of the Executive Committee.

Sec. 2. The First Vice President, in the absence of the President, will perform all the duties of that officer; the Second Vice President, in the absence of the President and First Vice President, will perform the duties of the presiding officer. The First and Second Vice Presidents shall also serve as members of the Executive Committee.

Sec. 3. The Secretary will attend all meetings of the Club or Executive Committee, keep full minutes of their proceedings, preserve the records and documents of the Club, accept and turn over all moneys received to the Treasurer at least once a month, draw cheques for all bills presented when approved by a majority of the Executive Committee present at any meetings of the Club, or Executive Committee meeting. He shall have charge of the publication of the Club Proceedings and perform other routine work pertaining to the business affairs of the Club under the direction of the Executive Committee.

Sec. 4. The Treasurer shall receipt for all moneys received from the Secretary, and deposit the same in the name of the Club within thirty days in a bank approved by the Executive Committee. All disbursements of the funds of the Club shall be by cheque signed by the Secretary and Treasurer.

Sec. 5. The Executive Committee will exercise a general supervision over the affairs of the Club and authorize all expenditures of its funds. The elective members of this Committee shall also perform the duties of an auditing committee to audit the accounts of the Club at the close of a term or at any time necessary to do so.

Sec. 6. The Finance Committee will have general supervision over the finances of the Club, and perform such duties as may be assigned them by the President or First and Second Vice Presidents.

Sec. 7. The Membership Committee will perform such duties as may be assigned them by the President or First and Second Vice Presidents, and such other duties as may be proper for such a committee.

ARTICLE VI.

ELECTION OF OFFICERS.

Sec. 1. The officers shall be elected at the regular annual meeting as follows, except as otherwise provided for:

Sec. 2. Written forms will be mailed to all the members of the Club, not less than twenty days previous to the annual meeting, by the three elective members of the Executive Committee. These forms shall provide a method, so that each member may express his choice for the several offices to be filled.

Sec. 3. The three elective members of the Executive Committee will present to the President the names of the members receiving the highest number of votes for each office, together with the number of votes received.

Sec. 4. The President will announce the result of the ballot and declare the election.

Sec. 5. Should two or more members receive the same number of votes, it shall be decided by a vote of the members present, by ballot.

ARTICLE VII.

AMENDMENTS.

Amendments may be made to this Constitution by written request of ten members, presented at a regular meeting and decided by a two-thirds vote of the members present at the next regular meeting.

BY-LAWS.

ARTICLE I.

MEETINGS.

Section 1. The regular meetings of the Club shall be held at Pittsburgh, Pa., on the fourth Friday of each month, except June, July and August, at 8:00 o'clock P. M.

Sec. 2. The annual meeting shall be held on the fourth Friday of October each year.

Sec. 3. The President may, at such times as he deems expedient, or upon request of a quorum, call special meetings.

ARTICLE II.

QUORUM.

At any regular or special meeting nine members shall constitute a quorum.

ARTICLE III.

DUES.

Sec. 1. The dues of members shall be $2.00 per annum, $1.00 of same to apply to subscription for Club Journal, payable in advance, on or before the fourth Friday of September each year.

Sec. 2. Each member will be assessed $1.00 extra annually to provide light refreshments for each meeting.

Sec. 3. At the annual meeting members whose dues are unpaid shall be dropped from the roll after due notice mailed them at least thirty days previous.

Sec. 4. Members suspended for non-payment of dues shall not be reinstated until all arrearages have been paid.

ARTICLE IV.

ORDER OF BUSINESS.

1—Roll call.
2—Reading of the minutes.
3—Announcements of new members.

4—Reports of Committees.
5—Communications, notices, etc..
6—Unfinished business.
7—New business.
8—Recess.
9—Discussion of subjects presented at previous meeting.
10—Appointment of committees.
11—Election of officers.
12—Announcements.
13—Financial reports or statements.
14—Adjournment.

ARTICLE V.

SUBJECTS—PUBLICATIONS.

Sec. 1. The Executive Committee will provide the papers or matter for discussion at each regular meeting.

Sec. 2. The proceedings or such portion as the Executive Committee may approve shall be published (standard size, 6x9 inches), and mailed to the members of the Club or other similar clubs with which exchange is made.

ARTICLE VI.

The stenographic report of the meetings will be confined to resolutions, motions and discussions of papers unless otherwise directed by the presiding officer.

ARTICLE VII.

AMENDMENTS.

These By-Laws may be amended by written request of ten members, presented at a regular meeting, and a two-thirds vote of the members present at the next meeting.

MEMBERS.

Ackenheil, J. D.,
District Sales Agent,
The Mamolith Carbon
Paint Co.,
1701 Arrott Building,
Pittsburgh, Pa.

Albree, Chester B.,
President and Chief Engineer,
Chester B. Albree Iron
Works Co.,
1115 Market St.,
N. S., Pittsburgh, Pa.

Alexander, J. R.,
Gen'l R. F. of E.,
Pennsylvania R. R. Co.,
Altoona, Pa.

Alleman, C. W.,
Chief Clerk to S. M. P.,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Allen, Harry L.,
Manager,
American Steel Foundries,
Alliance, Ohio.

Allen, Jas. P.,
Secretary,
Union Steel Castings Co.,
61st St. and A. V. Ry.,
Pittsburgh, Pa.

Allison, John,
Chief Engineer,
Pittsburgh Equipment Co.,
Glassport, Pa.

Altman, C. M.,
Asst. Foreman Car Insp.,
P. R. R. Co.,
R. F. D. No. 2,
Jeannette, Pa.

Amsbary, D. H.,
Manager, Dearborn Drug
& Chemical Co.,
Farmers Bank Building,
Pittsburgh, Pa.

Anderson, J. B.,
C. C. to S. M. P., P. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Andrews, Fred. G.,
Manager, Pittsburgh
Pit Post Co.,
Arrott Building,
Pittsburgh, Pa.

Angell, C. P.,
Ass't. Train Master,
B. and O. R. R. Co.,
312 Winston St.,
Pittsburgh, Pa.

Anthony, H. F.,
Telegraph Operator,
P. R. R. Co.,
7219 Finance St.,
Homewood Station,
Pittsburgh, Pa.

Arensberg, F. L.,
Rep., McCullough-Dalzell
Crucible Co.,
36th St. and A. V. Ry.,
Pittsburgh, Pa.

Armstrong, R. S.,
Mgr. Williams Disinfecting
Co.,
209 Seventh Street,
Pittsburgh, Pa.

Artzberger, L. C.,
Foreman,
H. K. Porter Co.,
5126 Dearborn St.,
Pittsburgh, Pa.

Ashley, F. B.,
Purchasing Dept., Penna
Lines, West of Pgh.,
Union Station,
Pittsburgh, Pa.

Atterbury, W. W.,
Fifth Vice President,
Pennsylvania R. R. Co.,
Philadelphia, Pa.

Atwood, J. A.,
Chief Engineer,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Ayers, H. B.,
Gen. Mgr., H. K. Porter Co.,
49th St. and A. V. Ry.,
Pittsburgh, Pa.

Backoski, Jos. G.,
Stenographer,
American S. S. & Mfg. Co.,
56th & Butler Sts.,
Pittsburgh, Pa.

Bailey, H. H.,
Yard Master,
P. R. R. Monon. Div.,
Monongahela, Pa.

Bailey, J. H.,
General Foreman,
56th St. Plant,
The McConway & Torley Co.,
Pittsburgh, Pa.

Bailey, R. E. L.,
Chief Clerk, American Spiral Spring and Mfg. Co.,
56th St. and A. V. Ry.,
Pittsburgh, Pa.

Baird, F. C.,
G. F. A., B. & L. E. R. R.,
Frick Building,
Pittsburgh, Pa

Baker, B. R.,
Rep., Gulf Refining Co.,
Gross St. and P. R. R.,
Pittsburgh, Pa.

Baker, C. L.,
Chief Clerk, Carnegie Steel Co. and Car Accountant,
Pgh. and Ohio Valley Ry., Vance Ave.,
Coraopolis, Pa.

Baker, Edwin H.,
Rep., Galena Signal Oil Co.,
26 Broadway,
New York, N. Y.

Baker, J. H.,
Clerk, M. P. Dept.,
P. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Baker, Jas. H.,
Forging Engineer,
316 Fourth Ave.,
Pittsburgh, Pa.

Baldwin, Stephen Y.,
Com. Frt. Agent,
D. & H. Co., Bessemer Bldg.,
Pittsburgh, Pa.

Baldwin, G. C.,
General Foreman,
Lumber Dept.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Ball, Geo. L.,
Sec'y and Treas.,
Ball Chemical Co.,
153 East Ohio St.,
Millvale, Pa.

Bannister, E. J.,
Rep., Crucible Steel Co. of America, 5621 Butler St.,
Pittsburgh, Pa.

Barker, A. E.,
Salesman,
Firth-Sterling Steel Co.,
Oliver Building,
Pittsburgh, Pa.

Barney, Henry E.,
Secretary and Treasurer,
Laughlin-Barney Machinery Co.,
Union Bank Bldg.,
Pittsburgh, Pa.

Barth, John W.,
Lemington Ave.,
12th Ward,
Pittsburgh, Pa.

Bartley, Milton,
President, American Nut & Bolt Fastener Co.,
P. O. Box 996,
Pittsburgh, Pa.

Barwis, J. McC.,
Fore. Insp'r., P. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Basford, G. M.,
Ass't to President,
American Loco. Co.,
30 Church St.,
New York, N. Y.

Battinhouse, John,
Inspector, W. A. B. Co.,
670A Middle Ave.,
Wilmerding, Pa.

Bealor, B. G.,
Vice Pres. and General Manager,
Althom Sand Co.,
421 Wood St.,
Pittsburgh, Pa.

Beatty, E. A.,
Foreman, American Locomotive Co.,
1429 Woodland Ave.,
N. S., Pittsburgh, Pa.

Beatty, E. G.,
Rep., Galena Signal Oil Co.,
Franklin, Pa.

Beatty, J. B.,
C. C., Car Shops,
Penna. R. R. Co.,
816 Sixth Ave.,
Altoona, Pa.

Bell, Walter,
Inspector, P. R. R. Co.,
Penna. Lines Bldg.,
Pittsburgh, Pa.

Belleville, J. M.,
General Freight Agent,
Pittsburgh Plate Glass Co.,
Frick Building,
Pittsburgh, Pa.

Bellows. A. B.,
Vice Pres't., Pittsburgh Testing Laboratory,
Pittsburgh, Pa.

Belsterling, C. S.,
Traffic Manager,
American Bridge Co.,
Frick Building,
Pittsburgh, Pa.

Beltz, John D.,
Engineer, B. & O. R. R. Co.,
219 Winston St.,
Pittsburgh, Pa.

Bengnot, J. J.,
General Foreman,
Pennsylvania Co.,
Alliance, Ohio.

Benner, Jacob W.,
C. E., Steam Power,
Carnegie Steel Co.,
Munhall, Pa.

Benner, Samuel A.,
Gen'l. Mgr. Sales,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Bennett, H. W.,
Clerk, Penna. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Bennett, R. G.,
Inspector, M. P. Dept.,
Penna. R. R. Co.,
32nd and Carson Sts.,
Pittsburgh, Pa.

Berg, Karl,
Draftsman, P. & L. E. R. R.,
224 Robinson St.,
Pittsburgh, Pa.

Berghane, A. L.,
Inspector, Westinghouse Air Brake Co.,
Pitcairn, Pa.

Beswick, John,
Ass't. Road Foreman of Engines, P. R. R. Co.,
2424 Beale Ave.,
Altoona, Pa.

Bigelow, Harry T.,
Rep., Hale & Kilburn Mfg. Co.,
Fisher Building,
Chicago, Ill.

Bihler, L. C.,
Traffic Manager,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Binns, J. Y.,
Special Agent,
Monongahela R. R. Co.,
Brownsville, Pa.

Bishop, J. B.,
Resident Inspector,
B. & O. R. R. Co.,
Water Street,
Pittsburgh, Pa.

Black, Frank J.,
Assistant Superintendent
Carnegie Steel Co.,
Island Ave.,
McKees Rocks, Pa.

Blackall, Robt. H.,
Railway Supplies,
1315 Farmers Bank Bldg.,
Pittsburgh, Pa.

Blakely, T. M.,
R. F. of E., Penna. R. R.,
Penna. Lines Bldg.,
Pittsburgh, Pa.

Bleasdale, Jas.,
Supervisor Air Brakes,
B. & O. R. R.,
526 Wallace Ave.,
Wilkinsburg, Pa.

Blest, M. C.,
Ass't. Engineer,
Pressed Steel Car Co.,
80 Euclid Ave.,
Bellevue, Pa.

Bogert, Wm. J.,
General Agent,
San Pedro, Los Angeles
and Salt Lake R. R.,
Oliver Building,
Pittsburgh, Pa

Bole, Robt. A.,
Manager, Manning, Maxwell
& Moore,
Park Building,
Pittsburgh, Pa.

Booth, Arthur,
Ass't. Gen'l. Pur. Agent,
Philadelphia Co.,
435 Sixth Ave.,
Pittsburgh, Pa.

Booth, Henry,
Road Foreman of Engines,
D. & H. Co.,
5 Canaan Street,
Carbondale, Pa.

Booth, J. K.,
Genl. Fore., B. & L. E. R. R.,
Greenville, Pa.

Booth, Jas.,
Rep., Midvale Steel Co.,
Oliver Building,
Pittsburgh, Pa.

Borland, W. P.,
Ass't. Treas. & Ass't. Sec'y.,
Rodman Chemical Co.,
East Pittsburgh, Pa.

Bottomly, E. S.,
Chief Joint Inspector,
B. and O., P. and R. and
C. V. Rys.,
Martinsburg, W. Va.

Boyd, Oliver,
Ass't. P. A., Union Switch
& Signal Co.,
7926 Tioga St.
Pittsburgh, Pa

Boyer, Chas. E.,
Ass't. Gen'l. Car Inspector,
P. R. R. Co.,
Room 206, Union Station,
Union Station,
Pittsburgh, Pa.

Boyle, H. Edgar,
Chief Clerk, Car Record Dept.,
Penna. Lines West of Pittsburgh, 1013 Penn Ave.,
Pittsburgh, Pa.

Brady, Daniel M.,
President, Brady Brass Co.,
95 Liberty Street,
New York, N. Y.

Brand, Thos.,
Train Master,
Montour R. R. Co.,
Coraopolis, Pa.

Brandt, E. K.,
Ass't. Train Master,
Penn'a R. R.,
Union Station,
Pittsburgh, Pa.

Branson, Craig R.,
M. P. Inspector,
Pennsylvania Co.,
302 West Berry St.,
Fort Wayne, Ind.

Bretz, F. K.,
General Manager, Morgantown and Kingwood R. R.
Morgantown, W. Va.

Brewster, Morris B.,
Rep., U. S. Metallic Packing Co., 6040 Jefferson Ave.,
Chicago, Ill.

Briggs, Ira Otis,
Train Dispatcher,
Pittsburgh Division,
P. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Briggs, Templeton,
Assistant Chief Inspector,
Carnegie Steel Co.,
Schoen Steel Works,
McKees Rocks, Pa.

Brower, R. M.,
Rep., American Brake Shoe & Foundry Co.,
30 Church St.,
New York, N. Y.

Brown, A. D.,
C. C. to Genl. Manager,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Brown, Alexander M.,
General Manager,
Zug Iron & Steel Co.,
Thirteenth and Etna Sts.,
Pittsburgh, Pa.

Brown, E. C.,
Chief Civil Engineer,
Carnegie Steel Co.,
Carnegie Building,
Pittsburgh, Pa.

Brown, J. Alexander,
Vice Prest. & Gen. Mgr.,
Pocket List of R. R. Officials,
75 Church St.,
15th Floor,
New York, N. Y.

Brown, John T.,
Vice Pres. and Genl. Manager,
Damascus Bronze Co.,
Allegheny, Pa.

Brown, John T., Jr.,
Supt. Duquesne Reduction Co.,
Farmers Bank Building,
Pittsburgh, Pa.

Brown, L. M.,
Salesman, McKenna Bros.,
253 Virginia Ave.,
Pittsburgh, Pa.

Brownscombe, G. J.,
Care Union R. R. Co.,
Port Perry, Pa.

Bruck, Henry T.,
Supt. Motive Power,
Cumberland & Penna. R. R.,
Mount Savage, Md.

Brunker, A. R.,
General Sales Agent,
American Steel Foundries,
Chester, Pa.

Bryant, C. W.,
Ass't. Chief Clerk to Sup't.,
B. & O. R. R.,
170 Marsden St.,
Pittsburgh, Pa.

Buchanan, A. H.,
Chief Clerk, Tracing Dept.,
Penna. Lines West of Pittsburgh,
Blenheim Apartments,
4925 Friendship Ave.,
Pittsburgh, Pa.

Buchanan, E. G.,
Rep., Carbon Steel Co.,
30 Church St.,
New York, N. Y.

Bucher, C. A.,
420 Pacific Ave.,
Pittsburgh, Pa.

Buechner, W. A.,
Railway Supplies,
Shannon Building,
Pittsburgh, Pa.

Bugle, Geo.,
Traveling Engineer,
Penna. R. R. Co.,
346 Miller St.,
Mt. Oliver, Pittsburgh, Pa.

Buffington, W. P.,
C. C. to Supt. Trans.,
Pittsburgh Coal Co.,
Hussey Building,
Pittsburgh, Pa.

Bulkley, B. M.,
Rep., Greene, Tweed & Co.,
8 Elsinore Apt., Craft Ave.,
Pittsburgh, Pa.

Bulkley, J. T.,
Rep., Jenkins Bros.,
300 N. Negley Ave.,
Pittsburgh, Pa.

Burgher, R.,
Factory Manager,
Kidd Bros. & Burgher
Steel Wire Co.,
Aliquippa, Pa.

Burke, William,
Assistant Yard Master,
Monon. Conn. R. R.,
405 Oakland Ave.,
Pittsburgh, Pa.

Burns, Robert C.,
Gen. A. B. and S. H.
Inspector, P. R. R. Co.,
1408 Eighth St.,
Altoona, Pa.

Burry, V. J.,
Chief Draftsman,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Butts, G. W.,
Ass't. Div. Operator
P. R. R. Co.,
Altoona, Pa.

Cage, G. N.,
Ass't. Road Foreman of
Engines, B. & O. R. R.,
Rockwood, Pa.

Cahill, M. H.,
Train Master,
B. and O. R. R.,
Water St.,
Pittsburgh, Pa.

Calvert, H. W.,
Round House Foreman,
P. & L. E. R. R.,
516 Marwood Ave.,
McKees Rocks, Pa.

Campbell, I. K.,
County Commissioner,
Pittsburgh, Pa.

Cardwell, J. R.,
Pres., Union Draft Gear Co.,
Monadnock Block,
Chicago, Ill.

Carpenter, Harry L.,
Central States Representative,
Ajax Metal Co.,
Westinghouse Bldg.,
Pittsburgh, Pa.

Carroll, J. T.,
Supt. Motive Power,
B. & O. R. R.,
House Building,
Pittsburgh, Pa.

Carson, G. E.,
Div. Master Car Builder,
N. Y. C. & H. R. R. R. Co.,
W. Albany, N. Y.

Carson, Robert, Jr.,
23 Terminal Way,
S. S., Pittsburgh, Pa.

Cassidy, D. E.,
Asst. M. M.,
P. R. R. Company,
1716 Middle St.,
Sharpsburg, Pa.

Chapin, E. S.,
care Penna. R. R. Co.,
Broad St. Station,
Philadelphia, Pa.

Chilcoat, H. E.,
Rep., Westinghouse Air
Brake Co.,
Westinghouse Building,
Pittsburgh, Pa.

Chittenden, A. D.,
Ass't. to Genl. Manager,
B. & L. E. R. R.,
Carnegie Bldg.,
Pittsburgh, Pa.

Christfield, J. C.,
Mechanical Engineer,
Forged Steel Wheel Co.,
Butler, Pa.

Christiansen, A.,
Chief Engineer,
Standard Steel Car Co.,
Butler, Pa.

Chrysler, W. P.,
Manager,
American Loco. Co.,
84 Sevelle Ave.,
Bellevue, Pa.

Clancy, J. R.,
1010 W. Belden Ave.,
Syracuse, N. Y.

Clark, C. C.,
Chief Clerk, Sales Dep't.,
Pressed Steel Car Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Clark, Chas. H.,
President, Clark Car Co.,
2121 Oliver Bldg.,
Pittsburgh, Pa.

Clark, E. J.,
Supervisor of Signals,
Penna. R. R. Co.,
East Liberty, Pa.

Clark, H. L.,
Railway Supplies,
Shannon Building,
Pittsburgh, Pa.

Clark, R. A.,
President, The Interlocking
Nut and Bolt Co.,
Farmers Bank Building,
Pittsburgh, Pa.

Clarke, Robert C.,
Surgeon, P. & L. E. R. R.,
129 So. Highland Ave.,
Pittsburgh, Pa.

Clifford, M. J.,
General Yard Master,
Monongahela R. R.,
Brownsville, Pa.

Cline, W. A.,
Asst. Supt. Transportation
and Labor,
Carnegie Steel Co.,
P. O. Box 507,
Munhall, Pa.

Coates, H. T., Jr.,
c. o. General Manager,
Penna R. R. Co.,
Broad Street Station,
Philadelphia, Pa.

Cochran, Chas. C.,
C. C. to Gen'l Manager,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Coffin, J. S.,
Vice President,
American Brake Shoe
& Fdy. Co.,
30 Church St.,
New York City, N. Y.

Coffin, W. E.,
Rep. National Malleable
Castings Co.,
7706 Platt Ave.,
Cleveland, O.

Coho, O. C.,
Engine House Foreman,
Penna. R. R. Co.,
Youngwood, Pa.

Cole, Jewett,
Enginehouse Foreman,
P. R. R. Co.,
207 Union Station,
Pittsburgh, Pa.

Collins, C. R.,
Ass't. Shop Clerk,
Penna. R. R. Co.,
28th St. Shops,
Pittsburgh, Pa.

Conley, Clark C.,
Train Dispatcher,
P. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Conneeley, E. K.,
Purchasing Agent,
P. & L. E. R. R. Co.,
Gen'l Office,
Pittsburgh, Pa.

Conroy, L. W.,
Ass't. Chief Inspector,
Schoen Steel Wheel Works,
McKees Rocks, Pa.

Conway, J. D.,
Secretary, Railway Supply
Manufacturer's Association,
Oliver Building,
Pittsburgh, Pa.

Cook, Joseph A.,
Ass't. Train Master,
Penn'a R. R.,
2843 Broadway Ave.,
Dormont Boro., Pa.

Cooper, F. E.,
Manager, R. R. Dept.,
J. A. & W. Bird Co.,
31 Union Square, W.,
New York, N. Y.

Cordner, A. C.,
Representing Bemis & Call
Hardware & Tool Co.,
Springfield, Mass.

Cosgrove, Hugh,
Foreman Freight Shop,
P. R. R. Co.,
Pitcairn, Pa.

Coudit, E. A., Jr.,
Rep., The Rail Joint Co.,
Oliver Building,
Pittsburgh, Pa.

Coulter, A. F.,
G. C. F., Union R. R. Co.,
Port Perry, Pa.

Courson, Chas. L.,
Fore. Car Inspectors,
P. R. R. Company,
Pitcairn, Pa.

Courson, J. F.,
General Foreman,
Pennsylvania R. R. Co.,
Pitcairn, Pa.

Courtney, D. C.,
1130 Sheffield St.,
Allegheny, Pa.

Cover, N. C.,
Chief Clerk to Gen. Foreman,
P. & L. E. R. R. Co.,
15 Tacoma Ave.,
Youngstown, O.

Cox, P. L.,
Road Master,
Monon. Con. R. R.,
2nd Ave. near Bates St.,
Pittsburgh, Pa

Craig, E. M.,
Smoke Inspector,
P. R. R. Co.,
601 West Railroad Ave.,
Oakmont, Pa.

Craig, E. A.,
South Eastern Manager,
Westinghouse Air Brake Co.,
Wilmerding, Pa.

Crawford, D. F.,
Genl. Supt. Motive Power,
Pennsylvania Lines West,
Pittsburgh, Pa.

Crawford, Harry M.,
Supervisor,
Monon. R. R. Co.,
Brownsville, Pa.

Crehan, J. H.,
Ass't. to President,
Gilmore & Pgh. R. R. Co.,
Machesny Bldg.,
Pittsburgh, Pa.

Crisfield, John W.,
Supt. Transportation,
Carnegie Steel Co.,
Clairton, Pa.

Criswell, A. B.,
Inspector, B. & O. R. R. Co.,
Water St.,
Pittsburgh, Pa.

Cromwell, S. A.,
General Car Inspector,
B. & O. R. R. Co.,
Pittsburgh, Pa.

Crouch, A. W.,
Dist. Manager, Dearborn
Drug & Chemical Co.,
Farmers Bank Building,
Pittsburgh, Pa.

Culbertson, O. F.,
General Yard Master,
D. & H. Ry.,
Carbondale, Pa.

Cullen, J. C.,
Train Master's Clerk,
Monongahela Connecting
R. R., Apartment No. 19,
The Oakland, Halket
and Forbes Sts.,
Pittsburgh, Pa.

Cullen, Jas. K.,
President,
Niles Tool Works,
Hamilton, Ohio.

Cunningham, J. D.,
Chief Clerk,
National Car Wheel Co.,
2075 W. 106th St.,
Cleveland, O.

Cunningham, R. I.,
Inspector, W. A. B. Co.,
418 West St.,
Wilkinsburg, Pa.

Currie, J. C.,
Rep., Nathan Mfg. Co.,
85 Liberty St.,
New York, N. Y.

Curtis, H. C.,
Clerk,
P., C., C. & St. L. R. R.,
Carnegie, Pa.

Dambach, C. O.,
Train Master,
Wabash-Pgh. Terminal Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Darlington, H. B.,
Ass't. Treas. Union
Spring & Mfg. Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Dashiell, J. W.,
F. & T. Agent, B. & O. R. R.,
Glenwood Station,
Pittsburgh, Pa.

Davis, H. J.,
Supt., St. Clair Terminal R. R.,
Clairton, Allegheny Co., Pa.

Davis, I. J.,
Superintendent,
Pressed Steel Car Co.,
1030 Fourth Ave.,
Coraopolis, Pa.

Davis, J. E.,
Master Mechanic,
Hocking Valley R. R.,
396 Stoddart Ave.,
Columbus, Ohio.

Davis, Thos. R.,
Mech. Expert,
Flannery Bolt Co.,
Pittsburgh, Pa.

Davison, N. C.,
Equipment Engineer,
Keenan Building,
Pittsburgh, Pa

Dean, A. E.,
Taylor & Dean,
Penn Ave. & 25th St.,
Pittsburgh, Pa.

Dean, Albert S.,
Clerk, Jones & Laughlin,
Woodlawn, Pa.

DeArment, John H.,
Foreman, Blacksmith Shop,
P. R. R. Co.,
P. O. Box 284,
Pitcairn, Pa.

Deckman, E. J.,
Rep., Hoppes Mfg. Co.,
Frick Building,
Pittsburgh, Pa.

Degener, P. A.,
Dempcy-Degener Co.,
Empire Bldg.,
Pittsburgh, Pa.

Delaplane, J. L.,
Storekeeper,
Pressed Steel Car Co.,
441 Jefferson St.,
Bellevue, Pa.

Demarest, T. W.,
Supt. Motive Power,
Pennsylvania Lines,
Ft. Wayne, Ind.

Demko, John H.,
Bookkeeper,
Universal Portland Cement
Co., 1132 Washington St.,
Braddock, Pa.

Dennis, James G.,
Train Dispatcher,
Penna. R. R. Co.,
Union Station,
Pittsburgh, Pa.

DeRemer, W. L.,
Rep., Spencer Otis Co.,
1707 Railway Exchange Bldg..
Chicago, Ill.

Detwiler, U. G.,
Foreman Car Shop,
Penna. R. R. Co.,
Verona, Pa.

Dickinson, F. W.,
M. C. B., B. & L. E. R. R. Co.,
Greenville, Pa.

Dobson, O. C.,
Salesman, Carborundum Co.,
Frick Annex,
Pittsburgh, Pa.

Donahey, I. W.,
Paymaster, U. R. R. Co.,
Port Perry, Pa.

Donahue, C. J..
Ass't. to Vice President,
American Loco. Co..
30 Church St.,
New York, N. Y.

Dorr. Charles O.,
Chief Clerk,
Monongahela R. R. Co..
Brownsville, Pa.

Dow, Geo. N.,
Genl. Mechanical Inspector,
L. S. & M. S. Ry. Co.,
Cleveland, Ohio.

Downes, D. F.,
Ass't. Train Master.
P. R. R. Co.,
Pittsburgh Division,
5648 Rural Ave.,
Pittsburgh, Pa.

Downing, I. S.,
Master Car Builder,
L. S. & M. S. Ry. Co.,
Collinwood, Ohio.

Downs, Joseph J.,
Train Dispatcher,
B. and O. R. R.,
67 Hazelwood Ave.,
Pittsburgh, Pa.

Doyle, A. J.,
Asst. Train Master,
Monon. Div., P. R. R. Co.,
Pittsburgh, Pa.

Drake, Thos. E.,
Clerk, Supt's. Office,
B. and O. R. R.,
4631 Chatesworth Ave.,
Pittsburgh, Pa.

Drake, W. C.,
Clerk, Office General Supt.,
B. & O. R. R.,
Pittsburgh, Pa.

Drane, Edward J.,
Asst. Chief Clerk,
Car Record Office,
Penna. Lines,
184 Sheridan Ave.,
Bellevue, Pa.

Dravo, M. S.,
Rep., Crucible Steel Co.
of America, Frick Building,
Pittsburgh, Pa.

Drawbaugh, E. L.,
Chief Car Inspector,
Cumberland Valley R. R.,
Chambersburg, Pa.

Drayer, U. S.,
Draftsman, P. R. R. Co.,
Altoona, Pa.

Dudley, G. W.,
Electrician,
Penna. R. R. Co..
32d and Carson Sts., S. S.,
Pittsburgh, Pa.

Duff, Samuel E..
Consulting Engineer,
Empire Building.
Pittsburgh, Pa.

Dunham, F. C.,
Special Sales Agent,
U. S. Metal & Mfg. Co.,
165 Broadway,
New York, N. Y.

Dunham, T. P.,
Rep. The Garlock Packing Co.
604 Arch St.,
Philadelphia, Pa.

Dunlevy, J. H.,
Freight Agent, Penna. Lines,
70 South 7th St.,
Pittsburgh, Pa.

Dussel, F. E.,
Secretary and Treasurer,
Transue & Williams Co.,
Alliance, Ohio.

Dyer, Jos.,
Chief Joint Inspector,
P. & L. E. and
Erie R. R. Cos.,
Youngstown, Ohio.

Earner, J. P.,
General Foreman,
B. & O. R. R. Co.,
2020 Lytle St.,
Hazelwood, Pa

Edmunds, Frank W.,
Sales Agent, The Dressel
Railway Lamp Works,
3860 Park Ave.,
New York, N. Y.

Eichenberger, J. J.,
Freight Cashier, Penna. Co.,
North and Irwin Aves.,
Allegheny, Pa.

Eichenlaub, W. C.,
Ass't. Sales Agent,
Union Steel Casting Co.,
61st St. & A. V. Ry.,
Pittsburgh, Pa.

Eissler, Robert F.,
Care Duquesne Steel
Foundry Co.,
Coraopolis, Pa.

Elliot, A. H.,
Representing,
American Brake Shoe and
Foundry Co.,
Real Estate Trust Bdg.,
Philadelphia, Pa.

Elliott, J. B.,
M. M., B. & O. R. R. Co.,
325 Boyles Ave.,
New Castle, Pa.

Elliott, M. W.,
Manager, Consumers Oil Co.,
1016 Congress St., N. S.,
Pittsburgh, Pa.

Elmer, Wm.,
S. M. P., B. and A. V. Div.,
P. R. R. Co.,
Buffalo, N. Y.

Emery, C. W.,
Yard Master, Monongahela
Connecting R. R.,
Second Ave., near Bates
St.,
Pittsburgh, Pa.

Evans, F. D.,
C. C., Treasury Dept.,
Pressed Steel Car Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Evans, Howard E.,
Asst. Foreman, P. R. R.,
32nd and Carson Sts.,
South Side,
Pittsburgh, Pa.

Evans, R.,
Penn'a. & Whitney Sts.,
Wilkinsburg, Pa.

Evans, R. J.,
V. P. & Gen'l Manager,
Franklin Mfg. Co.,
Franklin, Pa.

Evans, Sam'l R.,
Yard Master,
Monongahela R. R. Co.,
Newell, Fayette Co., Pa.

Everest, W. B.,
Traffic Manager, Westinghouse Elec. & Mfg., Co.,
East Pittsburgh, Pa

Faber, T. W.,
Mechanical Engineer,
Standard Steel Car Co.,
New Castle, Pa.

Fairman, H. T.,
A. G. Y. M., Penna Lines,
Eleventh St.,
Conway, Pa.

Falkenstein, W. H.,
Superintendent, Railway
Steel Spring Co.,
20th and Liberty Sts.,
Pittsburgh, Pa.

Faris, J. M.,
Master Mechanic,
Youngstown Sheet and
Tube Co.,
Youngstown, Ohio.

Farnan, O. E.,
Ass't. Train Master,
B. & O. R. R. Co.,
4631 Second Ave.,
Pittsburgh, Pa.

Fay, F. L.,
General Manager, Greenville
Metal Products Co.,
Greenville, Pa.

Feddersen, H. C.,
Ass't. Train Master,
Penn'a. R. R.,
Union Station,
Pittsburgh, Pa.

Fedelman, F. E.,
Master Mechanic,
Western Allegheny R. R.,
Kaylor, Pa.

Ferguson, D. E.,
Purchasing Agent,
H. K. Porter Co.,
49th Street,
Pittsburgh, Pa.

Ferguson, W. L.,
Secy., Jas. B. Sipe & Co.,
516 Federal St.,
Allegheny, Pa.

Ferron, Rob't. O.,
Locomotive Engineer,
Penna. R. R. Co.,
1233 Franklin St.,
Wilkinsburg, Pa.

Finegan, L.,
Master Mechanic,
B. & O. R. R. Co.,
Glenwood, Pa.

Fettinger, H. O.,
Rep., Clement Restein Co.,
133 N. Second St.,
Philadelphia, Pa.

Field, Arthur W.,
General Sales Agent,
Standard Motor Truck Co.,
Frick Annex,
Pittsburgh, Pa.

Finney, R.,
General Agent,
B. & O. R. R. Co.,
Oliver Building,
Pittsburgh. Pa.

Fitzpatrick, F. R.,
Asst. Engine Horse Foreman,
Penna. Lines West of
Pittsburgh,
1100 Allegheny Ave.,
N. S.,Pittsburgh, Pa.

Flaherty, P. J.,
Manager,
American Car and Ship
Hardware Mfg. Co.,
New Castle, Pa.

Flanigan, A. C.,
Freight Agent,
P. & L. E. R. R. Co.,
Coraopolis, Pa.

Flannery, Jas. J.,
Prest., Flannery Bolt Co.,
Frick Building,
Pittsburgh. Pa.

Flannery, Jos. M.,
General Manager,
The Vanadium Sales Co.
of America,
Frick Building,
Pittsburgh. Pa.

Fleck, J. S.,
Asst. Train Master,
P. R. R. Co.,
Union Station,
Pittsburgh. Pa.

Foggin, Geo. T.,
Foreman,
H. K. Porter Co.,
15 Dilworth St.,
Pittsburgh, Pa.

Foley, F. J.,
Manager, Railway Steel
Spring Company,
Pittsburgh, Pa.

Foller, Chas. S.,
Ass't. to President,
Union Spring & Mfg. Co.,
Farmers Bank Building,
Pittsburgh, Pa.

Foreman, Jacob E.,
Tank Shop Foreman,
P. R. R. Co., 28th St. Shops,
Pittsburgh, Pa.

Forgeus, E. E.,
P. O. Box 773,
St. Louis, Mo.

Forsythe, Geo. B.,
Foreman, Freight Car
Builders, Penna. Co.,
P. O. Box 95,
Conway, Pa.

Frame, R. S., Jr.,
Ass't. on Engineers Corps,
P. C. C. and St. L. Ry.,
29 Hawthorne Ave.,
Crafton, Pa.

Franey, J. F.,
General Foreman,
B. and O. R. R.,
Pittsburgh, Pa.

Frank, Laurence W.,
Sec., Duquesne Steel Fdy. Co.,
Arrott Building,
Pittsburgh, Pa.

Fray, Samuel,
General Sales Dep't.,
Carnegie Steel Co.,
Pittsburgh, Pa.

Freed, George F.,
Supt., Duff Mfg. Co.,
405 Merchant Ave.,
N. S., Pittsburgh, Pa.

Freshwater, F. H.,
Asst. Chief Draughtsman,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Froelich, J. H.,
Ass't. on Engineer Corps,
P. C. C. and St. L. Ry.,
39 North Linwood Ave.,
Crafton, Pa.

Frost, Harry W.,
President, The Frost
Railway Supply Co.,
Detroit, Mich.

Fuller, S. R., Jr.,
care Scullin-Gallagher
Iron & Steel Co.,
No. 1 Wall St.,
New York, N. Y.

Fullerton, A. W.,
Ass't. Pur. Agent,
Westinghouse Machine Co.,
East Pittsburgh, Pa.

Gale, C. H.,
Supt. Foundries,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Gallinger, Geo. A.,
Rest. Manager, Ind. Pneu.
Tool Co., Farmers Bank,
Pittsburgh, Pa.

Gano, J. H.,
Sup't., Aliq. & Southern Ry.,
Woodlawn, Pa.

Garaghty, W. C.,
Road Foreman of Eng's.,
B. & O. R. R.,
Newark, Ohio.

Gearhart, H. J.,
Purchasing Agent,
Pressed Steel Car Co.,
665 Maryland Ave.,
Pittsburgh, Pa.

Gearhart, J. A.,
Manager, Inspection Dept.,
Gulick-Henderson Co.,
439 Third Ave.,
Pittsburgh, Pa.

Geddes, Jas. R.,
C. C. to Gen'l. Manager,
Monon. Connecting R. R.,
2nd Ave. near Bates St.,
Pittsburgh, Pa.

George, M. E.,
Car Foreman,
Union R. R. Co.,
Port Perry, Pa.

Gibb, J. B.,
Clinton Apartments,
10th & Spruce Sts.,
Philadelphia, Pa.

Gibson, Frank,
C. C. to Supt.,
Union R. R. Co.,
516 South Ave.,
Wilkinsburg, Pa.

Gibson, Wm. S.,
Engr., M. of W.,
Union R. R. Co.,
Port Perry, Pa.

Gies, Geo. E.,
General Foreman,
Pennsylvania Company,
1529 Garfield Ave.,
N. S., Pittsburgh, Pa.

Gifford, Charles,
Rep., Monarch Steel
Castings Co.,
Detroit, Mich.

Gildroy, Geo. J.,
Supt. M. & H. Div.,
Lehigh Valley R. R. Co.,
Hazelton, Pa.

Gilg, Henry F.,
1223 Island Ave.,
N. S., Pittsburgh, Pa.

Gillespie, John M.,
G. S. A., Lockhart Iron &
Steel Company,
McKees Rocks, Pa.

Gillooly, J. J.,
Ass't. Chief Shipper,
Carnegie Steel Co.,
Schoen Steel Wheel
Works,
McKees Rocks, Pa.

Glass, H. M.,
Ass't. Round House Foreman,
Allegheny Valley Ry.,
Forty-eighth St.,
Pittsburgh, Pa.

Glassburn, S. G.,
Ass't. Road Foreman of
Engines, P. R. R. Co.,
Conemaugh, Pa.

Goff, John P.,
Yard Master,
P. & L. E. R. R.,
118 Mill St.,
Coraopolis, Pa.

Gold, Egbert H.,
Car Heating Apparatus,
Railway Exchange Building,
Chicago, Ill.

Good, H. J.,
Traveling Car Inspector,
Union R. R. Co.,
502 Stokes Ave.,
Braddock, Pa.

Gorby, F. E.,
Chief Clerk to Supt.,
B. & O. R. R. Co.,
New Castle, Pa.

Gowdy, H. K.,
Chief Engineer Power
Stations, Pittsburgh
Railways Company,
231 Charles St.,
Mt. Oliver Station.
Pittsburgh, Pa.

Graham, Chas. J.,
Sec., Graham Nut Co.,
400 Roup Place,
Pittsburgh, Pa.

Graham, H. E.,
General Freight Agent,
Pressed Steel Car Co.,
Pittsburgh, Pa.

Graham, W. C.,
Manager of Works,
Standard Steel Car Co.,
New Castle, Pa.

Gray, G. B.,
Signal Inspector,
Penna. Lines West,
Union Station,
Pittsburgh, Pa.

Gray, Guy M.,
S. M. P.,
B. & L. E. R. R. Co.,
Greenville, Pa.

Gray, Robert,
Locomotive Engineer,
P. & L. E. R. R. Co.,
Brunot Avenue,
Esplen Boro, Pittsburgh, Pa.

Green, Harry W.,
District Sales Agent,
American Steel Foundries,
36th St and A. V. Ry.,
Pittsburgh, Pa.

Grewe, H. F.,
Gen'l Foreman Mech'l Dept.,
Wabash-Pittsburgh Ter.
Ry. Co.,
Carnegie, Pa.

Grieves, E. W.,
Rep., Galena Signal Oil Co.,
1756 Park Ave.,
Baltimore, Md.

Griffith, W. R.,
Inspector, B. & O. R. R. Co.,
Water St.,
Pittsburgh, Pa.

Griswold, W. W.,
Secretary to Receivers,
Wabash-Pgh. Terminal Ry.,
Pittsburgh, Pa.

Groobey, Geo.,
Rep., Buckeye Steel
Castings Co.,
Rennert Hotel,
Baltimore, Md.

Grose, Jas. H.,
Supt., Howard Axle Works,
Carnegie Steel Co.,
Homestead, Pa.

Grove, E. M.,
Treasurer,
McConway & Torley Co.,
48th St. and A. V. Ry.,
Pittsburgh, Pa.

Grooms, J. C.,
G. R. E. & C. A.,
P. & L.E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Guay, J. W.,
Representing Fort Pitt
Steel Casting Co.,
McKeesport, Pa.

Gulick, Henry,
Pres., Gulick-Henderson Co.,
439 Third Ave.,
Pittsburgh, Pa.

Gumbes, J. H.,
Asst. Supt., Pittsburgh Div.
P. R. R. Co.,
Youngwood, Pa.

Gurry, George,
Superintendent,
American Loco. Co.,
Allegheny, Pa.

Guthrie, John B.,
Sales Manager, American
Steam Gauge and Valve
Mfg. Co.,
Jenkins Arcade Bldg.,
Pittsburgh, Pa.

Gutierrez, S. J.,
Inspector, P. R. R. Co.,
208 Collins Ave.,
Pittsburgh, Pa.

Guy, W. A.,
Ass't. Foreman,
Penna. Co.,
Conway, Pa.

Hackenburg, J. H.,
Ass't. Pur. Agent,
Pressed Steel Car Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Hagerty, E. D.,
Ass't. Storekeeper,
Penna. R. R. Co.,
28th St. Shops,
Pittsburgh, Pa.

Hallett, H. M.,
Rep., Penna. Crusher Co.,
Machesney Building,
Pittsburgh, Pa.

Halliwell, C. J.,
Asst. M. M., P. R. R. Co.,
Twenty-eighth St.,
Pittsburgh, Pa.

Hamilton, Wm.,
President, Erie Car Works,
Erie, Pa.

Hamilton, William,
Manager Railway Dept.,
Billings-Chapin Co.,
Fort Pitt Hotel,
Pittsburgh, Pa.

Hammond, H. S.,
Sales Agent,
Pressed Steel Car Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Hansen, J. M.,
President,
Standard Steel Car Co.,
Frick Building,
Pittsburgh, Pa.

Hardman, H. J.,
C. C. to M. M.,
Penna. R. R. Co.,
Liberty Ave. & 28th St.,
Pittsburgh, Pa.

Haring, Ellsworth,
Rep., Herman Boker & Co.,
684 A Hancock St.,
Brooklyn, N. Y.

Harrigan, P. J.,
Car Foreman,
McKeesport Conn. R. R.,
716 South Evans Ave.,
McKeesport, Pa.

Harriman, Henry A.,
Clerk, Wabash-Pgh.
Terminal Ry. Co.,
Wabash Building,
Pittsburgh, Pa.

Harris, J. D.,
503 Forest Road,
Roland Park, Md.

Harner, A. J.,
Traveling Engineer,
Monon. Div.,
Penna. R. R. Co.,
West Brownsville, Pa.

Hastings, Chas. L.,
General Sales Manager,
American Vanadium Co.,
Pittsburgh, Pa.

Hauger, D. M.,
C. C. to Supt.,
P. & L. E. R. R.,
General Offices,
Pittsburgh, Pa.

Hauser, W. M.,
C. C., Accounting Dept.,
Wabash-Pgh. Terminal
Ry., Wabash Building,
Pittsburgh, Pa.

Hawk, Robert,
Yard Master, P. R. R. Co.,
7524½ Hamilton Ave.,
Pittsburgh, Pa.

Hawkins, M. E.,
Air Brake Instructor,
Penna. R. R. Co.,
657 Herron Ave.,
Pittsburgh, Pa.

Hawthorne, F. M.,*
Ass't. on Engineer Corps,
P. C. C. & St. L. Ry.,
88 Emily St.,
Crafton, Pa.

Hay, Paul L.,
Sam'l. W. Hay's Sons,
Keenan Building,
Pittsburgh, Pa.

Hayes, R. F.,
Eastern Manager,
The Curtain Supply Co.,
Hudson Terminal,
50 Church St.,
New York, N. Y.

Hayes, Scott R.,
Rep. Railway Steel Spring Co.,
30 Church St.,
New York, N. Y.

Haynes, J. E.,
General Foreman,
Pittsburgh Coal Co.,
Coraopolis, Pa.

Heady, T. B.,
Sales Agent,
Vulcan Crucible Steel Co.,
Renshaw Building,
Pittsburgh, Pa.

Helm, E. E.,
Ass't. Train Master,
P. R. R. Co.,
P. O. Box 951,
California, Pa.

Hench, Norman M.,
Engr. Track Appliances,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Henderson, J. W.,
Manager, Verona Works,
Standard Steel Car Co.,
Verona, Pa.

Henry, J. S.,
Manager, N. E. Dis't.,
Safety Car Heating and
Lighting Co.,
2 Rector St.,
New York, N. Y.

Hepburn, M. J.,
M. P. Clerk., P. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Herlehy, Thos. W.,
Carnegie Steel Co.,
5633 Second Ave.,
Pittsburgh, Pa.

Herr, H. W.,
Div. Engineer,
Pittsburgh Coal Co.,
1718 Crosby Ave.,
Beechview, Pittsburgh, Pa.

Hickey, A. F.,
Chief Clerk,
The Canfield Oil Co.,
Coraopolis, Pa.

Hilberry, H. H.,
M. M., Penna. Lines,
Toledo, O.

Hill, Chas. E.,
Salesman, Crucible Steel Co.
of America,
Frick Building,
Pittsburgh, Pa.

Hill, G. W.,
Signal Superviser,
P. C. C. & St. L. Ry.,
28 Haldane Ave.,
Crafton, Pa.

Hilty, Harry A.,
Foreman Car Repairs,
P. R. R.,
171 Mayflower St.,
Pittsburgh, Pa.

Hinsdale, C. L.,
General Foreman,
P. & L. E. R. R. Co.,
8 E. Chalmers Ave.,
Youngstown, O.

Hoffman, Chas. T.,
Gang Foreman,
Penna. R. R.,
Youngwood, Pa.

Hoffman, N. K.,
Supt. Car Service,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Hoffstot, H. P.,
Ass't. to General Manager,
Pressed Steel Car Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Hokanson, M.,
General Manager, Iron City
Testing Laboratory,
Phipps Power Building,
Pittsburgh, Pa.

Hollein, Wm.,
Engineer, Power Plant,
Penna. R. R. Co.,
32d and Carson Sts., S. S.,
Pittsburgh, Pa.

Holt, Thos. W.,
Storekeeper,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Hood, D. G.,
General Agent,
P. & L. E. R. R. Co.,
Pittsburgh, Pa.

Howard, C. H.,
President, Commonwealth
Steel Company,
Pierce Building,
St. Louis, Mo.

Howe, David M.,
Manager,
Jos. Dixon Crucible Co.,
Wabash Building,
Pittsburgh, Pa.

Howe, Dean,
Asst. Chief Electrician,
Universal Portland Cement
Co.,
Universal, Pa.

Howe, W. C.,
Ass't. Supt.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Huber, H. G.,
Ass't. Master Mechanic,
Penna R. R.,
Harrisburg, Pa.

Hudson, Wm. L.,
Road Foreman Engines,
P. R. R. Co., Union Station,
Pittsburgh, Pa.

Huff, C. A.,
Gang Foreman,
28th Street Shops,
P. R. R. Co.,
5010 Penn Ave.,
Pittsburgh, Pa.

Hughes, J. E.,
Yard Master,
P. & L. E. R. R.,
Glassport, Pa.

Hukill, J. L.,
232 Home Ave.,
Avalon, Pa.

Humphrey, A. L.,
Vice Pres. and Gen. Manager,
Westinghouse Air Brake
Company,
Wilmerding, Pa.

Hunter, D., Jr.,
Dist. Manager, Under Feed
Stoker Co. of America,
Park Building,
Pittsburgh, Pa.

Hunter, Frank A.,
Sec. and Treas., Hunter
Saw & Machine Co.,
57th and Butler Sts.,
Pittsburgh, Pa.

Hunter, H. S.,
Pittsburgh Manager,
Chicago Pneumatic Tool Co.,
1019 Jancy St.,
Pittsburgh, Pa.

Huntley, F. P.,
Vice Pres't. & Gen'l. Mgr.,
Gould Coupler Co.,
347 5th Ave.,
New York, N. Y.

Huyett, E. G.,
Standard Steel Car Co.,
Frick Building,
Pittsburgh, Pa.

Hussey, John U.,
223 Fourth Ave.,
Pittsburgh, Pa.

Hyndman, F .T.,
Rep., S. F. Bowser & Co.,
724 North 63rd St.,
Philadelphia, Pa.

Hyndman, H. R.,
Asst. General Freight Agent,
Washington Run R. R. Co.,
Conestoga Building,
Pittsburgh, Pa.

Hyndman, N. P.,
Genl. Freight & Pass. Agent,
Washington Run R. R. Co.,
Conestoga Building,
Pittsburgh, Pa.

Ickes, Ellwood T.,
Metallurgical Dept.,
Carnegie Steel Co.,
Carnegie Building,
Pittsburgh, Pa.

Irwin, Oliver,
Pass. Conductor,
Penna. Lines West,
53½ Pittsburgh St.,
New Castle, Pa.

Isler, Chas. J.,
Div. Operator,
Penn. R. R. Co.,
South 30th St.,
Pittsburgh, Pa.

Isler, J. C.,
Chief Time Clerk,
Monongahela R. R.,
Brownsville, Pa.

Jack, C. H.,
Clerk, Supt's. Office,
B. and O. R. R.,
413 Chestnut St.,
Versailles, Pa.

Jefferson, E. Z.,
Jefferson Rubber Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Jenney, Jacob,
G. F. C. R.,
Monon. Div., P. R. R. Co.,
30th St., S. S.,
Pittsburgh, Pa.

Johnson, A. J.,
Supt., B., R. & P. Ry. Co.,
DuBois, Pa.

Johnson, C. A.,
General Foreman,
American Spiral Spring
and Mfg. Co.,
56th St. and A. V. Ry.,
Pittsburgh, Pa.

Johnson, I. S.,
Resident Inspector,
Test Dept.. Penna R. R. Co.,
1013 Penn Ave.,
Pittsburgh, Pa.

Johnson, J. E.,
Manager,
Garlock Packing Co.,
Pittsburgh, Pa.

Johnson, Walter A.,
Salesman, Independent
Pneumatic Tool Co.,
Farms Bank Building,
Pittsburgh, Pa.

Johnson, Wallace W.,
General Manager,
Standard Magnesia Co.,
752 N. 40th St.,
Philadelphia, Pa.

Johnston, Guy S.,
Ass't. Civil Engineer,
Universal Portland Cement
Company,
626 Lilly Ave.,
Braddock, Pa.

Johnston, W. C.,
Special Agent,
Sligo Iron and Steel Co.,
Pusey Apartments, N. S.,
Pittsburgh, Pa.

Jones, E. A.,
Gang Foreman,
28th Street Shops,
P. R. R. Co.,
7711 Kelly Street, ,
Pittsburgh, Pa.

Jones, Julian D.,
Ass't. Div. Operator, P. R. R.,
Room 302, Union Station,
Pittsburgh, Pa.

Jones, L. W.,
General Manager,
Cyclops Foundry Co.,
Union Bank Building,
Pittsburgh, Pa.

Jones, W. A.,
Ass't. Engine House Foreman, Penna. Co.,
286 Jefferson St.,
Rochtester, Pa.

Jordan, James E.,
Piece Work Inspector,
P. R. R. Co.,
189 Mayflower St., E. E.,
Pittsburgh, Pa.

Kalbaugh, I. N.,
Supt., Motive Power,
Coal & Coke Ry.,
Gassaway, W. Va.

Karnes, W. T.,
General Foreman,
P. & L. E. R. R.,
Newell, Pa.

Kaup, H. E.,
Ass't. Supt.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Keagy, C. O.,
Gen'l. Foreman, P. R. R. Co.,
W. Philadelphia, Pa.

Keenoy, R. P.,
Supt., Trans., American
Steel & Wire Co.,
15th St. and Penn Ave.,
Pittsburgh, Pa.

Keithley, J. T.,
General Foreman,
H. C. Frick Coke Co.,
500 Eleanor Ave.,
Scottdale, Pa.

Kelley, Wm. V.,
Pres't, Am. Steel Foundries,
Chicago, Ill.

Kelly, H. B.,
Traveling Fireman.
P. and L. E. R. R.,
904 Page St.,
McKees Rocks, Pa.

Kennedy, James,
Jt. Foreman Car Repairs,
M. C. & P. & L. E. R. R.,
32nd Street, South Side,
Pittsburgh, Pa.

Kennedy, W. J.,
Clerk, B. & O. R. R.,
600 Liberty St., N. S.,
Pittsburgh, Pa.

Keppel, A. M.,
Superintendent,
Washington Terminal Co.,
Union Station,
Washington, D. C.

Keptner, J. B.,
Coal Inspector,
P. & L. E. R. R.,
1527 Napoleon St.,
Beechview,
Pittsburgh, Pa.

Kerr, Edward,
President,
Lawrenceville Bronze Co.,
31st St. and Penn Ave.,
Pittsburgh, Pa.

Kessler, Howard,
Engine Dispatcher,
P. & L. E. R. R.,
McKees Rocks, Pa.

Kessler, D. D.,
Locomotive Engineer,
P. & L. E. R. R.,
1428 Rockland Ave.,
Pittsburgh, Pa.

Kewley, E. C.,
Asst. Supt.,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Khuen, Richard,
Resident Engineer,
American Bridge Co.,
Frick Annex,
Pittsburgh, Pa

Kight, H. R.,
Master Mechanic,
Western Maryland R. R.,
Elkins, W. Va.

Kinney, M. A.,
Supt. Motive Power,
Hocking Valley Ry.,
Columbus, O.

Kinney, C. D.,
Master Mechanic,
Kanawha & Michigan Ry.,
Middleport, O.

Kinter, D. H.,
General Foreman, Car. Dept.,
Monongahela R. R. Co.,
Brownsville, Pa.

Kirk, T. S.,
326 Amber St.,
Pittsburgh, Pa.

Kissinger, C. F.,
Asst. Train Master,
P. R. R. Co.,
30th & Sarah Sts., S. S.,
Pittsburgh, Pa.

Kleine, R. L.,
Chief Car Inspector,
P. R. R. Company,
Altoona, Pa.

Kleinhans, H.,
Oliver Building,
Pittsburgh, Pa.

Klee, W. B.,
President,
Damascus Bronze Co.,
Pittsburgh, Pa.

Klingensmith, W. H.,
Foreman, Blacksmith Shop,
P. R. R. Co.,
32nd and Carson Sts., S. S.,
Pittsburgh, Pa.

Knapp, A. D.,
Vice President,
Nicola Lumber Co.,
Farms Bank Bldg.,
Pittsburgh, Pa.

Knickerbocker, A. C.,
Draftsman,
American Bridge Co.,
Sheffler Plant, 48th St.,
Pittsburgh, Pa.

Knight, E. A.,
Foreman Car Dep't.,
Pennsylvania Co.,
Conway, Pa.

Knox, E. E.,
Pgh. Manager,
Bury Compressor Co.,
2545 Liberty Ave.,
Pittsburgh, Pa.

Knox, Wm. J..
Mechanical Engineer,
B. R. & P. Ry. Co.,
DuBois, Pa.

Koch, Felix,
Chief Draughtsman,
Pressed Steel Car Co.,
P. O. Box 290,
Allegheny, Pa.

Koch, H. J.,
Secretary, Fort Pitt
Steel Castings Co.,
McKeesport, Pa.

Koelbel, Chas. H.,
Master Mechanic,
Monarch Steel Casting Co.,
347 Grand Boulevard W.,
Detroit, Mich.

Kull, W. A.,
Storekeeper,
Monongahela Con. R. R.,
2nd Ave., near Bates St.,
Pittsburgh, Pa.

Kurzhals, Chas. L.,
Transfer Foreman,
Penna. Co.,
188 Madison St.,
Rochester, Pa.

LaMar, A..
Master Mechanic,
Penna. Lines,
55th and Normal Ave.,
Chicago, Ill.

Lambert, G. J.,
General Yard Master,
P. & L. E. R. R. Co.,
711 Camp St.,
McKees Rocks, Pa.

Lanahan, Frank J.,
President, Fort Pitt
Mall. Iron Co.,
P. O. Box 1054,
Pittsburgh, Pa.

Lane, E. G.,
Eng'r. M. of W.,
B. & O. R. R.,
Water St. Station,
Pittsburgh, Pa.

Lang, W. C.,
Ass't. Gen'l. Foreman Car
Shops, P. & L. E. R. R..
719 George St.,
Coraopolis, Pa.

Lanning, C. S.,
Mgr., J. F. Lanning & Co.,
239 Fourth Ave.,
Pittsburgh, Pa.

Lanning, J. F.,
Pres't, J. F. Lanning & Co.,
239 Fourth Ave.,
Pittsburgh, Pa.

Laughlin, C. W.,
Rep., Manning, Maxwell &
Moore, Park Bldg.,
Pittsburgh, Pa.

Law, F. H.,
Commercial Agent,
Illinois Central R. R.,
Oliver Building,
Pittsburgh, Pa.

Layng, F. R.,
Engineer of Track,
Bessemer & Lake Erie R. R.,
Greenville, Pa.

Leary, E. B.,
Rep., Diamond Rubber Co.,
St. Louis, Mo.

Lee, L. A.,
Supt., Telegraph,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Lehr, Harry W.,
Asst Fore. Car Insp.
P. R. R. Co.
6832 McPherson Blvd.,
Pittsburgh, Pa.

Leonard, E. J.,
Traveling Inspector,
United Coal Co.,
Bank for Savings Bldg.,
Pittsburgh, Pa.

Leonard, James, Jr.,
Clerk, Frt. Train Master's
Office, Penn'a R. R. Co
Union Station,
Pittsburgh, Pa.

Leonard, P. G.,
Road Foreman of Engines,
Hocking Valley R. R.,
Columbus, Ohio.

Lewis, A. J.,
Car Distributor,
Monongahela R. R. Co.,
South Brownsville, Pa.

Lewis, O. M.,
General Yard Master,
Wabash-Pgh. Ter. Ry.,
1304 Methyl St.,
Pittsburgh, Pa.

Lewis, T. L.,
Salesman, The Fairbanks Co.,
5826 Morrowfield Ave.,
Pittsburgh, Pa.

Lincoln, L. P.,
Supt., Fitting Dept.,
Homestead Steel Works,
Munhall, Pa.

Lindstrom, Chas. A.,
Chief Engineer,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Little, J. S.,
Ass't. R. F. Eng's.,
B. & O. R. R.,
Newark, Ohio.

Little, P. C.,
General Manager,
Cleaning Devices Mfg. Co.,
Empire Building,
Pittsburgh, Pa.

Lobez, P. L.,
Draftsman, Westinghouse
Air Brake Company,
418 Swissvale Ave.,
Wilkinsburg, Pa.

Lockhard, Jos. A.,
Clerk, Penna. R. R. Co.,
7236 Race St.,
Homewood, Pa.

Lockhart, J. C.,
Representing, H. W. Johns-Manville Co.,
951 Liberty Ave.,
Pittsburgh, Pa.

Lockwood, B. D.,
Ass't. Chief Engineer,
Pressed Steel Car Co.,
444 Dawson Ave.,
Bellevue, Pa.

Long, Chas. R., Jr.,
Prest., Chas. R. Long & Co.,
622-630 East Main St.,
Louisville, Ky.

Long, R. M.,
Road Foreman Engines,
P. & L. E. R. R. Co.,
McKees Rocks, Pa.

Low, John R.,
Chief Clerk,
Duquesne Steel
Foundry Co.,
..Coraopolis, Pa.

Lowe, W. D.,
Chief Draftsman,
Wabash-Pgh. Terminal Ry.,
420 Hastings St.,
Pittsburgh, Pa.

Lowry, R. N.,
Mech. Engr.,
Arthur Koppel Co.,
Machesney Bldg.,
Pittsburgh, Pa.

Lustenberger, L. C.,
Rep., Carnegie Steel Co.,
Carnegie Building,
Pittsburgh, Pa.

Lybarger, J. H.,
Clerk, Office D. F. A.,
Penna. R. R. Co.,
Room 221 Union Station,
Pittsburgh, Pa.

Lynn, Sam'l,
Master Car Builder,
P. & L. E. R. R.,
McKees Rocks, Pa.

Macfarlane, W. E.,
Ass't. R. F. of E.,
Penna. R. R.,
Elrama,
Washington Co., Pa.

Mackenzie, R. H.,
Clerk, General Supt.'s Office,
Penn'a. R. R. Co.,
Room 318, Union Station,
Pittsburgh, Pa.

Mackert, A. A.,
Chief Inspector, W. A. B. Co.,
450 Caldwell Ave.,
Wilmerding, Pa.

Maher, J. V.,
Fort Pitt Malleable Iron Co.,
McKees Rocks, Pa.

Mallen, R.,
R. F. of E., B. & O.
Southwestern R. R.,
Chillicothe, Ohio.

Malloy, M. A.,
Master Mechanic,
Monon Div., P. R. R. Co.,
32nd & Carson Sts., S. S.,
Pittsburgh, Pa.

Marshall, James H.,
Master Mechanic,
Universal Portland Cement
Co., Box 924,
Homestead, Pa.

Marshall, W. H.,
President, Amer. Loco. Co.,
Cortlandt Bldg.,
30 Church St.,
New York, N. Y.

Martin, John M.,
Engineer, Drawing Room 5,
American Bridge Co.,
Ambridge, Pa.

Martin, W. H.,
Asst. Foreman, Freight Shop,
P. R. R. Co.,
P. O. Box 114,
Pitcairn, Pa.

Mason, Allan B.,
Storekeeper,
Monon. Connect. R. R.,
4166 Second Ave.,
Pittsburgh, Pa.

Mason, E. F.,
Care Gen'l. Sup't. M. P.,
Altoona, Pa.

Mason, F. N.,
Secretary and Treasurer,
Universal Flexible Packing
Co.,
3109 Penn Ave.,
Pittsburgh, Pa.

Mason, Stephen C.,
Secretary,
McConway & Torley Co.,
48th St. & A. V .Ry.,
Pittsburgh, Pa.

Matthews, J. A.,
Foreman Pass. Cars,
P. & L. E. R. R.,
Pittsburgh, Pa.

Maxfield, H. H.,
Master Mechanic,
Penna. R. R. Co.,
Pittsburgh, Pa.

Maxson, H. W.,
Sales Department,
Carnegie Steel Co.,
Pittsburgh, Pa.

Meckel, O. P.,
Secretary, Baird Machy. Co.,
123 Water St.,
Pittsburgh, Pa.

Menaugh, Norman S.,
Train Dispatcher,
Pittsburgh Division,
P. R. R. Co.,
433 Biddle Ave.,
Wilkinsburg, Pa.

Mensch, E. M.,
Ass't. Shop Clerk,
Penna. Company,
Conway, Pa.

Mercur, H. T.,
Rep. Ry. Materials Co.,
Old Colony Bldg.,
Chicago, Ill.

Metcalf, Harry E.,
Rep., Ingersoll-Rand Co.,
I Bellefonte Apartments,
Bellefonte and Elmer Sts.,
Pittsburgh, Pa.

Michel, Wm. J.,
Rep., National Lead and Oil
Co. of Penna.,
Commonwealth Bldg.,
Pittsburgh, Pa.

Millar, Clarence W..
Head Order Dept.,
Pressed Steel Car Co.,
96 Jackson St.,
Bellevue, Pa.

Miller, F. L.,
Agent, P. R. R. Co.,
Shady Side Station,
Pittsburgh, Pa.

Miller, Jno. F.,
Vice President, Westinghouse
Air Brake Company,
Pittsburgh, Pa.

Miller, John F.,
Yard Master,
Aliquippa & Southern
R. R. Co.,
Woodlawn, Pa.

Miller, Orlando,
P. O. Box 1025,
Pasadena, Cal.

Milligan, J .D.,
Chief Surgeon.
P. & L. E. R. R. Co.,
Bank for Savings Bldg.,
Pittsburgh, Pa.

Milliken, I. H.,
Rep., McConway & Torley Co.,
48th St. and A. V. Ry.,
Pittsburgh, Pa.

Milliken, John M.,
Supt. Car Equipment,
Gulf Refining Co.,
Frick Annex.
Pittsburgh, Pa.

Milliron, E. L.,
Manager, Pgh. Branch,
S. F. Bowser Co.,
Oliver Building,
Pittsburgh, Pa.

Milner, B. B.,
Ass't. Master Mechanic,
P. B. and W. R. R.,
Wilmington, Del.

Miner, W. H.,
Railway Supplies,
669 Rookery Building,
Chicago, Ill.

Mitchell, A. G.,
Supt., P. R. R. Co.,
3000 Sarah St.,
S. S., Pittsburgh, Pa.

Mohler, T. A.,
General Foreman Car Shop,
Western Maryland R. R.,
Elkins, W. Va.

Montague, W. T.,
Motive Power Inspector,
Penna. R. R. Co.,
207 Union Station,
Pittsburgh, Pa.

Montgomery, H.,
Master Mechanic,
Penn'a. R. R. Co.,
Oil City, Pa.

Morris, Jack M.,
Extra Train Dispatcher,
Penna. R. R. Co.,
7424 Idlewild St.,
Pittsburgh, Pa.

Morse, Jr., R. C.,
Ass't. Yard Master,
Penn'a. R. R.,
34 East Pittsburgh Street,
Greensburg, Pa.

Mooney, J. A.,
Storekeeper,
Wabash-Pgh. Ter. Ry.,
Rook, Pa.

Moore, John L.,
Ass't. Sec'y. and Treas.,
Monon. Connecting R. R.,
Jones & Laughlin Bldg.,
Pittsburgh, Pa.

Moore, Lee C.,
Consulting Engineer
and Manufacturer,
341 Sixth Ave.,
Pittsburgh, Pa.

More, F. E.,
M. P. Inspector,
Penna. Lines West of Pgh.,
Ft. Wayne, Ind.

Morgan, Clinton A.,
Train Master,
D. & H. Co.,
15 Brooklyn St.,
Carbondale, Pa.

Morgan, Dwight C.,
V. P. & G. M., Pittsburgh
& Shawmut R. R.,
Kittanning, Pa.

Mowry, A. T.,
Ass't. Enginehouse Foreman,
Penna. R. R. Co.,
Alter St.,
Wall, Pa.

Mowry, F.,
Asst. Road Foreman of
Engines, Penna. R. R. Co.,
Derry, Pa.

Mowry, Jas. G.,
Railway Rep.,
Patton Paint Co.,
50 Church St.,
New York, N. Y.

Muhlfeld, J. E.,
Vice Pres. & Gen'l. Mgr.,
Kansas City Southern R. R.,
Kansas City, Mo.

Murdoch, Harry,
Pres't., H. Murdoch & Co.,
Sailor Building,
Pittsburgh, Pa.

Murphy, W. J.,
Foreman, Boiler Shop,
Penna. Company,
3614 Michigan Ave.,
Allegheny, Pa.

Murphy, W. C.,
Train Dispatcher,
P. R. R. Co.,
2324 Woodstock Ave.,
Swissvale, Pa.

McAdoo, J. H.,
General Agent,
C. & A. Ry. Co.,
Park Building,
Pittsburgh, Pa.

McAndrews, J.,
G. Y. M., Penna Lines West,
Freedom, Pa.

McCandless, Geo. W.,
Auditor,
McConway & Torley Co.,
48th St. and A. V. Ry.,
Pittsburg, Pa.

McCartney, J. L. ,
Rep., Niles Bement Pond Co.,
Frick Building,
Pittsburgh, Pa.

McCaslin, A. W.,
Master Blacksmith,
P. & L. E. R. R. Co.,
McKees Rocks, Pa.

McCauley, Wm.,
Ass't. R. F. of E.,
Penna. R. R.,
P. O. Box 72,
Youngwood, Pa.

McClellan, A. W.,
Supervisor,
Penna. R. R. Co.,
Trafford, Pa.

McClintock, John D.,
Rep., Wm. Sellers & Co., Inc.,
1600 Hamilton St.,
Philadelphia, Pa.

McCloskey, J. C.,
Clerk,
Union R. R. Co.,
Port Perry, Pa.

McCloy, John H.,
Salesman,
Zug Iron and Steel Co.,
13th and Etna Sts.,
Pittsburgh, Pa.

McClumpha, H. E.,
Supt., National Car
WheelCompany,
Homestead, Pa.

McConnell, C. H.,
Electrician,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

McConnell, J. H.,
168 No. Sycamore Ave.,
Hollywood, Cal

McConnell, P. L.,
Asst. Road Foreman of
Engines, Allegheny Division,
Penna. R. R. Co.,
5206 Butler St.,
Pittsburgh, Pa.

McConway, Wm., Jr.,
Superintendent,
McConway & Torley Co.,
48th St. and A. V. Ry.,
Pittsburgh, Pa.

McCrea, Archibald M.,
President,
Union Spring & Mfg. Co.,
Farmers Bank Building,
Pittsburgh, Pa.

McCully, John,
Shop Clerk,
P. R. R. Co.,
Verona, Pa.

McCune, Frank,
General Manager, Monon.
Connecting R. R. Co.,
2nd Ave. near Bates St.,
Pittsburgh, Pa.

McDaniel, Chas. W.,
Rep. Fiske Bros. Refining Co.,
Empire Building,
Pittsburg, Pa.

McDermitt, W. W.,
Chief Clerk to Gen'l. Foreman,
P. R. R. Co.,
Pitcairn, Pa.

McDonnell, F. V.,
Master Mechanic,
Penna. Co.,
331 Boyle Ave.,
New Castle, Pa.

McElheny, M. L.,
Train Dispatcher,
B. and O. R. R.,
427 Hallett Place,
Bellevue, Pa.

McFeatters, F. R.,
Superintendent,
Union R. R. Co.,
Port Perry, Pa.

McGaughey, Chas.,
Storekeeper,
Penna. R. R. Co.,
1022 Franklin Ave.,
Wilkinsburg, Pa.

McGraw, Wm. P.,
Sup't. of Cars,
Jamison Coal & Coke Co.,
Oliver Buiding,
Pittsburgh, Pa.

McGrory, Percy,
Engineman,
Wabash-Pgh. Terminal Ry.,
533 Main St
Carnegie, Pa.

McIlwain, J. D.,
Care C. M. Trinler,
Woodlawn, Pa.

McKee, Frank W.,
Sup't. Electrical Dep't.,
J. & L. Co.,
Woodlawn, Pa.

McKee, E. L.,
Gen'l. Fore., Carpenters,
P. & L. E. R. R. Co.,
McKees Rocks, Pa.

McKee, S. Frank,
Labor Agent,
Pressed Steel Car Co.,
McKees Rocks, Pa.

McKeen, J. W.,
Rep., Matthews-Davis
Tool Co.,
7620 Tioga St.,
Pittsburgh, Pa.

McKenna, Wm. H.,
McKenna Bros. Brass Co.,
First Ave. & Ross St.,
Pittsburgh, Pa.

McMaster, H. W.,
Gen. Supt., Wabash-
Pittsburgh Terminal Ry.,
Pittsburgh, Pa.

McMaster, R. T.,
Inspecting Engineer,
P. & L. E. R. R. Co.,
830 Seventh Ave.,
Coraopolis, Pa.

McNaight, A. H.,
Reconsignment Clerk,
Penna. Lines West of
Pittsburgh,
846 Columbus Ave.,
N. S., Pittsburgh, Pa.

McNulty, F. M.,
S. M. P. & R. S., Monon.
Connecting R. R. Co.,
2nd Ave. near Bates St.,
Pittsburgh, Pa.

McVicar, G. E.,
Expert,
Galena Signal Oil Co.,
Care The Benedick,
Washington, D. C.

Neale, Jas.,
Secretary, Brown & Co.,
Tenth Street,
Pittsburgh, Pa.

Neale, John C.,
Asst. Genl. Mangr. of Sales,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Neely, J. L.,
Div., F. A., Am. Sheet
& Tin Plate Co.,
Frick Bldg.,
Pittsburgh, Pa.

Neilson, Allan,
C. C., Car Record Office,
Penna. Co.,
1366 Montezuma St.,
Pittsburgh, Pa.

Neison, W. J.,
Auditor, Freight Acct's.,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Newbury, E. H.,
Ass't. Master Mechanic,
Penna. R. R. Co.,
32nd & Carson Sts.,
Pittsburgh, Pa.

Newsom, H. H.,
Gen. Mgr., McCord & Co.,
2587 Grand Boulevard,
Detroit, Mich.

Neylon, J. F.,
General Manager,
Wm. Harris & Sons Co.,
709 Belmont St., N. S.,
Pittsburgh, Pa.

Nickerson, S. N.,
Agent, P. R. R. Co.,
Duquesne, Pa.

Nicol, Geo. A.,
Representing, H. W. Johns-
Manville Co.,
21 N. Second St.,
Philadelphia, Pa.

Niemeyer, C. H.,
Division Engineer,
Penna. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Noble, D. C.,
President, Pittsburgh
Spring & Steel Co.,
1417 Farmers Bank Bldg.,
Pittsburgh, Pa

Noble, H. S.,
Foreman Shops,
Penna. R. R. Co.,
State Line, Pa.

Noland, J. J.,
V. P., Hutchins Car
Roofing Company,
Hyde Park, Pa.

Oates, Geo. M.,
Foreman Painter,
Pressed Steel Car Co.,
429 Jucunda St.,
Knoxville, Pa.

Obey, G. B.,
Superintendent,
Monongahela R. R. Co.,
Brownsville, Pa.

O'Brien, W. O.,
Road Master,
Wabash-Pgh. Ter. Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

O'Connor, Charles,
District Manager, Continental
Iron & Steel Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

O'Connor, M.,
Rep., Chicago Pneumatic
Tool Co.,
10-12 Wood St.,
Pittsburgh, Pa.

Ogden, F. A.,
General Freight Agent,
Jones & Laughlin Steel Co.,
Pittsburgh, Pa.

Ogden, Geo. D.,
Ass't. G. F. A., P. R. R. Co.,
Broad St. Station,
Philadelphia, Pa.

O'Leary, D. W.,
Rolling Mill Foreman,
Carnegie Steel Co., Schoen
Steel Wheel Works,
405 Russelwood Ave.,
McKees Rocks, Pa.

Oliver, W. H.,
Frt. Agent, Penna. Co.,
North and Irwin Aves.,
Allegheny, Pa.

O'Neal, Wm. J.,
Inspector,
Union R. R. Co.,
309 Lobinger Ave.,
Braddock, Pa.

Orbin, Geo. N.,
Engineman, B. & O. R. R.,
4841 Lytle St.,
Pittsburgh, Pa.

Orchard, Chas.,
Transportation Agent,
Carnegie Steel Co.,
Munhall, Pa.

Orner, Milton T. S.,
Chief Clerk to District
Freight Solicitor,
Penna. Co., Oliver Bldg.,
Pittsburgh, Pa.

Orr, J. W.,
Asst. to Comp.,
Penna. Lines West,
Union Station,
Pittsburgh, Pa.

Osmund, C. M.,
Shipping Clerk,
American Spiral Spring
and Mfg. Co.,
5604 Camelia St.,
Pittsburgh, Pa.

Painter, Jos.,
Ry. Eq., 248 Fourth Ave.,
Pittsburgh, Pa.

Pape, Chas. F.,
Mgr., Manufacturing Dep't
Hutchins Car Roofing Co.,
Hyde Park, Pa.

Parry, Wm. I.,
Engineer and Salesman,
Carnegie Steel Co.,
Carnegie Building,
Pittsburgh, Pa.

Patterson, R. F.,
Electrical Engineer,
Pressed Steel Car Co.,
McKees Rocks, Pa

Peach, Wm. M.,
Supt. Pass. Car Dept.,
Pressed Steel Car Co.,
468 Forrest Ave.,
Bellevue, Pa.

Peacock, W. W.,
Resident Manager,
Vandyck Churchill Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Pechstein, Albert J. G.,
Electrician, The McConway
& Torley Co.,
48th St. & A. V. Ry.,
Pittsburgh, Pa.

Peter, Philip,
Mg'r. Sales,
Central Ry. Signal Co.,
509 Columbia Bank Bldg.,
Pittsburgh, Pa.

Peters, W. P.,
Lieutenant of Police,
P. R. R. Co.,
P. O. Box 492,
Freeport, Pa.

Pfarr, Jacob,
Mach. Shop Foreman,
Penna. R. R. Co.,
Pitcairn, Pa.

Pfeil, Geo.,
Ass't. General Foreman,
American Spiral Spring
and Mfg. Co.,
56th St. and A. V. Ry.,
Pittsburgh, Pa.

Pfeil, John,
President, American
Spiral Spring and Mfg. Co.,
Pittsburgh, Pa.

Phelps, W. H., Jr.,
Special Agent, P. R. R.,
Union Line,
1722 Ridge Ave.,
Coraopolis, Pa.

Phillips, Jas. B.,
Clerk, Monongahela
Connecting R. R.,
2nd Ave. and Bates St.,
Pittsburgh, Pa.

Phillips, Lee,
Representative,
National Radiator Co.,
Carnegie, Pa.

Pickels, H. D.,
Ass't. C. C. to Gen'l. Mgr.,
Monon. Connect. R. R.,
Second Ave. and Bates St.
Pittsburgh, Pa.

Pinson, J. H.,
Care Davenport
Locomotive Works,
Davenport, Iowa.

Pitzer, Edwin H.,
Yard Master, Pgh. Div.,
Penna. R. R. Co.,
7939 Tacoma St.,
Pittsburgh, Pa.

Platt, J. G.,
Mech. Rep., Hunt-Spiller
Manufacturing Corp.,
2112 W. Baltimore St.,
Baltimore, Md.

Plunkett, Thos.,
Rep., Revere Rubber Co.,
168 Lake Street,
Chicago, Ill.

Porter, Chas.,
Genl. Agent, Youghiogheny
& Ohio Coal Co.,
No. 910 House Building,
Pittsburgh, Pa.

Porter, H. V.,
C. C. to Pur. Agent,
B. & L. E. R. R. Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Porter, H. T.,
Chief Engineer,
B. & L. E. R. R. Co.,
Greenville, Pa.

Post, Geo. A.,
President,
Standard Coupler Co.,
2 Rector St.,
New York, N. Y.

Postlethwaite, C. E.,
Manager of Sales,
Central District,
Pressed Steel Car Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Pratt, Howard A.,
Oliver Building,
Pittsburgh, Pa.

Prickman, W. R.,
Agent, Wabash-Pgh.
Terminal Ry.,
113 Dinsmore Ave.,
Crafton, Pa.

Prosser, C. S.,
Asst. Manager,
Peerless Rubber Mfg. Co.,
16 Warren Street,
New York, N. Y.

Prout, Col. H. G.,
V. P. and Genl. Manager,
Union Switch & Signal Co.,
Swissvale, Pa.

Proven, John,
Superintendent, Pittsburgh
Spring & Steel Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Publow, John,
C. C. to Train Master,
B. & O. R. R. Co.,
Water St.,
Pittsburgh, Pa.

Pulliam, O. S.,
General Mgr., Pittsburgh
Equipment Company,
1268 House Bldg.,
Pittsburgh, Pa.

Purdy, W. F.,
Chief Engineer, Wabash-
Pgh. Terminal Ry.,
Pittsburgh, Pa.

Pyle, Philip S.,
Train Dispatcher,
P. R. R. Co.,
5539 Ellsworth Ave.,
Pittsburgh, Pa.

Quest, W. O.,
Foreman Painter,
P. & L. E. R. R. Co.,
McKees Rocks, Pa.

Quigley, G. E.,
1652 W. Monroe St.,
Chicago, Ill.

Rabold, W. E.,
Shop Clerk, P. R. R. Co.,
Liberty Ave. & 28th St.,
Pittsburgh, Pa.

Radcliff, C. R.,
Traveling Fireman,
B. and O. R. R.,
214 Towbridge St.,
Pittsburgh, Pa.

Rader, B. H.,
Eastern S. A., Universal
Portland Cement Co.,
Frick Bldg.,
Pittsburgh, Pa.

Rae, W. C.,
Sales Manager,
Edwards Co.,
326 Dunlap Ave.,
Pittsburgh, Pa.

Rafferty, C. D.,
Ass't. Sup't.,
Slick Car Wheel Plant,
Homestead Steel Works,
Munhall, Pa.

Ralston, John A.,
Chief Inspector,
Carnegie Steel Co.,
Carnegie Building,
Pittsburgh, Pa.

Ralston, J. S.,
President,
Ralston Steel Car Co.,
First Nat'l Bank Bldg.,
Columbus, Ohio.

Ransley, F. E.,
Rep., Greene, Tweed & Co.,
226 Lake St.,
Chicago, Ill.

Raser, Geo. B.,
Rep., Ingersoll-Rand Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Rea, C. S.,
Sales Manager,
Ralston Steel Car Co.,
P. O. Box 656,
Pittsburgh, Pa.

Redding, D. J.,
Ass't. Supt. Motive Power,
P. & L. E. R. R. Co.,
McKees Rocks, Pa.

Rees, Harry S.,
Chief Clerk, Per Diem and
Mileage Dept., Penna. Co.,
7028 Frankstown Ave.,
Pittsburgh, Pa.

Reese, F. T.,
Rep., Inter Ocean Steel Co.,
531 Collins Ave.,
Pittsburgh, Pa.

Regan, W. J.,
Mechanical Engineer,
McConway & Torley Co.,
48th St. and A. V. Ry.,
Pittsburgh, Pa.

Reilly, Robert,
C. C. to Gen'l. S. M. P.,
Penna. Lines,
109 Allegheny Ave.,
Emsworth, Pa.

Rennie, Geo. J.,
Asst. Supt., Carnegie Steel Co.
204 Western Ave.,
Aspinwall, Pa.

Rhine, Geo. B.,
Engine House Foreman,
Penna. R. R. Co.,
32nd & Carson Sts.,
Pittsburgh, Pa.

Rhodes, G. P.,
Secretary and Treasurer,
National Car Wheel Co.,
Penna. & Grant Aves.,
N. S., Pittsburgh, Pa.

Rhodes, Jas. D.,
President,
National Car Wheel Co.,
Penna. & Grant Aves.,
N. S., Pittsburgh, Pa.

Rhodes, P. L.,
Salesman, Homestead
Valve Mfg. Co.,
Homestead, Pa.

Rhuark, F. W.,
Master Mechanic,
B. & O. R. R.,
Lorain, Ohio.

Rice, D. S.,
Foreman Boiler Shop,
Penna. R. R. Co.,
28th St. Shops,
Pittsburgh, Pa.

Richardson, C. A.
Engineer,
B. & O. R. R. Co.,
127 Johnston Ave.,
Pittsburgh, Pa.

Richardson, E. F.,
Genl. Air Brake Inspector,
B. & L. E. R. R.,
Greenville, Pa.

Richardson, E. M.,
Manager,
Sherwin-Williams Co.,
50 Church St.,
New York, N. Y.

Richardson, S. W.,
Yard Master,
Penna. R. R. Co.,
Box 52,
Courtney, Pa.

Richardson, W. P.,
Mechanical Engineer,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Riddell, W. J.,
G. Y. M., P. R. R. Co.,
6731 Hamilton Ave.,
Pittsburgh, Pa.

Rider, J. B.,
General Manager,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Riley, J. W.,
Superintendent,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Riley, Geo. N.,
Supt. Motive Power,
McKeesport Con. R. R. Co.,
Frick Building,
Pittsburgh, Pa.

Riley, T. J.,
Engine House Foreman,
Penna. R. R. Co.,
48th Street,
Pittsburgh, Pa.

Rinehart, H. W.,
Inspector, M. P. Dept.,
P. R. R. Co.,
28th Street,
Pittsburgh, Pa.

Rivinius, Carl,
Piece Work Insp.,
Penna. R. R. Co.,
Pitcairn, Pa.

Robbins, F. S.,
Ass't. R. F. of E.,
P. R. R. Co.,
Renova, Pa.

Roberts, W. P.,
Material Inspector,
New York Central Lines,
General Office,
P. & L. E. R. R.,
Pittsburgh, Pa.

Robertson, Jas. D.,
President, Warren
Tool and Forge Co.,
Bessemer Bldg.,
Pittsburgh, Pa.

Robinson, S. R.,
care Duquesne Steel Fdy. Co.,
Coraopolis, Pa.

Rogan, John A.,
M. M., Div. No. 1,
Pgh. Railways Co.,
125 Auburn St.,
Pittsburgh, Pa.

Rogers, R. E.,
Treasurer, Jas. B. Sipe Co.,
Drawer 550,
N. S., Pittsburgh, Pa.

Rohn, W. B.,
Chief Clerk,
Pressed Steel Car Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Root, E. E.,
Foreman, P. R. R. Co.,
222 Market St.,
Brownsville, Pa.

Rosenstock, J. H.,
Supt. Susquehanna Div.,
D. and H. Co.,
Oneonta, N. Y.

Routh, Chas. M.,
Chief Draftsman,
Schoen Steel Wheel Works,
814 Wager St.,
Munhall, Pa.

Rowand, Will H.,
Rep., W. W. Lawrence & Co.,
Pittsburgh, Pa.

Rupp, R. D.,
Stenographer, M. P. Dept.,
P. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Russom, T. H.,
Supt. Car Dept.,
B. & O. R. R. Co.,
Baltimore, Md.

Ryan, William F.,
Car Fore., B. & O. R. R. Co.,
100 Generta St.,
Pittsburgh, Pa.

Rys, C. F. W.,
Met. Engineer,
Carnegie Steel Co.,
Carnegie Building,
Pittsburgh, Pa.

Sadd, L. C.,
Secretary,
T. H. Nevin Co.,
Pittsburgh, Pa.

Sager, Wm. B.,
Yard Master,
Monon. R. R. Co.,
West Brownsville,
Washington Co., Pa.

Sampson, Jas. M.,
Metallurgist,
McConway & Torley Co.,
48th St. & A. V. Ry.,
Pittsburgh, Pa.

Sanderson, M. W.,
Manager, Carborundum Co.,
Frick Annex.
Pittsburgh, Pa.

Sandman, A. G.,
Chief Draftsman,
B. & O. R. R.,
2310 Roslyn Ave.,
Walbrook,
Baltimore, Md.

Sands, J. H.,
Master Plumber,
P. R. R. Co.,
32nd and Carson Sts., S. S.,
Pittsburgh, Pa.

Sargeant, W. A.,
General Manager,
Consolidated Lamp &
Glass Co.,
1630 Ridge Ave.,
Coraopolis, Pa.

Sargent, F. W.,
Chief Engineer, American
Brake Shoe & Foundry Co.,
Mahwah, N. J.

Sargent, L. L.,
Ass't. R. F. of E.,
Penna. R. R. Co.,
N. W. Cor. Park and
Maple Ave.,
Greensburg, Pa.

Sattley, E. C.,
Manager, Page
Woven Wire Fence Co.,
Monessen, Pa.

Schaefer, Frederic,
Mechanical Engineer,
Summers Steel Car Co.,
Oliver Building,
Pittsburgh, Pa.

Schaffer, R. H.,
Clerk, Office Gen'l Supt.,
Penna. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Schauer, A. J.,
Ass't. Train Master,
Mon. Div., P. R. R. Co.,
237 Rochelle St.,
S. S., Pittsburgh, Pa.

Scheck, H. G.,
Road Foreman Engines,
Monon. Div., P. R. R. Co.,
32nd St., S. S.,
Pittsburgh, Pa.

Schiller, John,
Traveling Con'dr.,
Wabash-Pgh. Ter. Ry.,
Wabash Bldg.,
Pittsburgh, Pa.

Schlacks, W. J.,
Sales Agent, McCord & Co.,
Peoples Gas Bldg.,
Chicago, Ill.

Schleiter, W. F.,
Sec., Dilworth, Porter & Co.,
313 Sixth Ave.,
Pittsburgh, Pa.

Schneider, G. C.,
Engine House Foreman,
Penna. R. R. Co.,
South Fork, Pa.

Schoen, W. H.,
President,
Stove and Range Co.
of Pittsburgh,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Schoeneman, Chas. J.,
513 Gross St.,
Pittsburgh, Pa.

Schomberg, Wm. T.,
Foreman, Smith Shop,
Pennsylvania Company,
1209 Resaca Place,
Allegheny, Pa.

Schoming, Geo.,
Foreman Smith Shop,
Penna. R. R. Co.,
529 Lobinger Ave.,
Braddock, Pa.

Schoonmaker, J. M.,
Vice President,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Schoonover, W. H.,
Clerk, Office Gen'l. Supt.,
P. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Schoyer, A. M.,
General Superintendent,
Penna. Lines West,
Pittsburgh, Pa.

Schreiner, W. C.,
Manager, Main Belting Co.,
33 Terminal Way,
Pittsburgh, Pa

Schuchman, W. R.,
Sec. & Treasurer,
Homestead Valve Mfg. Co.,
Homestead, Pa.

Schultz, Geo. H.,
Inspector,
Penna. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Scott, W. A., Jr.,
President, American Car
Screen Co.,
Ferguson Building,
Pittsburgh, Pa.

Scott, W. M.,
Train Dispatcher,
P. & L. E. R. R.,
625 Ivy St., E. E.,
Pittsburgh, Pa.

Searles, E. J.,
Asst. G. S. M. P.,
B. & O. R. R. Co.,
Baltimore, Md.

Severance, F. W.,
Sec. and Treas.,
S. Severance Mfg. Co.,
Glassport, Pa.

Shannon, Chas.,
Rep., Lowe Bros. Co.,
210 Winebiddle Ave.,
Pittsburgh, Pa.

Shelhart, Frank,
Ass't. Storekeeper,
Penna. R. R. Co.,
28th St. Shops,
Pittsburgh, Pa.

Shipe, Warren E.,
Clerk, M. P. Dept.,
Penna. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Shook, S. D.,
Manager,
Star Brass Mfg. Co.,
Fulton Building,
Pittsburgh, Pa.

Shuck, Wm. C.,
with Lockhart Iron &
Steel Company,
Pittsburgh, Pa.

Shumaker, F. S.,
Foreman,
Penna. Co.,
Beaver, Pa.

Silk, Edward E.,
Sales Agent,
Bettendorf Axle Co.,
1510 McCormick Bldg.,
Chicago, Ill.

Simpson, T. H.,
President, Michigan
Mall. Iron Co.,
Detroit, Mich.

Simpson, M. S.,
Representing
Pressed Steel Car Co.,
Farmers Bank Bldg.,
Pittsburgh, Pa.

Sims, David H.,
Yard Master,
P. & L. E. R. R. Co.,
Lock Box 26,
Pittock P. O., Pa.

Simm, J. C.,
Treasurer,
Machinists' Supply Co.,
Pittsburgh, Pa.

Sinclair, Angus,
President and Editor Ry. and
Locomotive Engineering,
Millburn, N. J.

Sipe, Geo. T.,
Treas., Jas. B. Sipe & Co.,
516 Federal St.,
Allegheny, Pa

Slemmer, W. M.,
Inspector,
Union R. R. Co.,
Port Perry, Pa.

Slick, E. E.,
Chief M. E., Carnegie
Steel Co., Carnegie Bldg.,
Pittsburgh, Pa.

Slifer, Hiram J.,
care Chicago Great
Western Ry.,
Chicago, Ill.

Slocum, C. V.,
Special Agent,
Titanium Alloy Mfg. Co.,
5500 Irwin Ave.,
Pittsburgh, Pa.

Slocum, Roy L.,
Ass't. Supt., Universal
Portland Cement Co.,
520 Holmes St.,
Wilkinsburg, Pa.

Smith, A. D.,
Supt., Canfield Oil Co.,
Fourth Ave.,
Coraopolis, Pa.

Smith, D. W.,
Foreman Painter.
Pennsylvania Lines West,
N. S., Pittsburgh, Pa.

Smith, Edward B.,
Rep., American Brake Shoe &
Foundry Co.,
30 Church St.,
New York, N. Y.

Smith, Geo. H.,
M. E.,
Carnegie Steel Co.,
28 Fourth St.,
Aspinwall, Pa.

Smith, Harley G.,
Rep., Cleveland Twist
Drill Company,
Cleveland, Ohio.

Smith, James,
Supt., Lawrenceville
Bronze Co.,
31st St. and Penn Ave.,
Pittsburgh, Pa.

Smith, M. A.,
Fore., P. & L. E. R. R. Co.,
Glassport, Pa.

Smith, Russell,
Master Mechanic,
Pressed Steel Car Co.,
McKees Rocks, Pa.

Smith, W. A.,
Vice Pres't., Lino Paint Co.,
Collinwood, Ohio.

Smith, Willard A.,
President Railway Review,
Manhattan Building,
Chicago, Ill.

Snitchurst, Jas. G.,
Engine House Foreman,
Penna. R. R. Co.,
P. O. Box 35,
Youngwood, Pa.

Snow, Walter T.,
Rep., James B. Sipe & Co.,
526 Grimes St.,
Sewickley, Pa.

Snyder, F. I.,
care of B. & L. E. R. R. Co.,
Carnegie Building,
Pittsburgh, Pa.

Snyder, Jos.,
General Foreman,
P. & L. E. R. R.,
P. O. Box 52,
Dickerson Run, Pa.

Snyder, J. Rush,
President, Ellwood Coal, Oil
and Gas Company,
Fulton Building,
Pittsburgh, Pa.

Snyder, K. G.,
Purchasing Agent,
Western Allegheny R. R.
Co., Diamond Bank Bldg.,
Pittsburgh, Pa.

Soles, G. H.,
Supt. Bridges and Buildings,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Soulsby, Jos.,
Yard Master,
Penna. R. R. Co.,
438 Railroad St.,
Monongahela, Pa.

Stafford, B. E. D.,
General Manager,
Flannery Bolt Company,
Pittsburgh, Pa.

Stafford, Saml. G.,
P., Vulcan Crucible Steel Co.,
Aliquippa, Pa.

Staley, P. C.,
Gen'l. Foreman,
Penna. R. R. Co.,
314 Babcock St.,
Buffalo, N. Y.

Stark, F. H.,
Supt. Rolling Stock,
Pittsburgh Coal Company,
Coraopolis, Pa.

Stark, Jas. L.,
Gen'l. Insp'r. Car Dept.,
Hocking Valley Ry.,
Spahr Bldg.,
Columbus, O.

Steele, W. K.,
Chief Car Distributor,
P. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Stem, L. H.,
Inspector,
Rock Island Lines,
Oliver Building,
Pittsburgh, Pa.

Stevenson, R. F.,
Chief Clerk to Freight Agent,
P. R. R. Co.,
College Ave.,
Oakmont, Pa.

Stewart, C. A.,
Asst. Station Master,
B. & O. R. R.,
4738 Lytle St.,
Pittsburgh, Pa.

Stewart, S. R. B.,
Train Dispatcher,
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In Memoriam

LOUIS S. KLEIN

Louis S. Klein, a fellow-member of this Club, died October 27th, 1911, and the committee appointed to prepare a minute on his death, desire to record the following resolution:

Whereas, It has pleased our Heavenly Father to remove from our midst out late associate; therefore, be it

Resolved, By The Railway Club of Pittsburgh that we deeply deplore his demise and extend to his bereaved family and relatives our sincere sympathy in their sad affliction and mourn with them in their irreparable loss; and be it further

Resolved, That these resolutions be spread upon the minutes of this Club and a copy of same sent to his family.

J. D. CONWAY,
WM. P. McGRAW,
Committee.

In Memoriam.

JULIUS KRAUSE

Julius Krause, General Car Inspector, Western Pennsylvania Division, Pennsylvania Railroad, was born in Saxony, Germany, on October 15th, 1846, and died at his home in Wilkinsburg, Pa., on October 7th, 1911. When he was but a small boy his parents came to this country and settled in Butler County, Pennsylvania. He entered the service of the Pennsylvania Railroad Company at Torrens Shops, near the present location of the East Liberty Station, in December, 1864. He was promoted to Car Inspector in 1868; to Foreman of Car Inspectors, Pittsburgh Division in 1875; and to General Car Inspector, Western Pennsylvania Division, connected with the office of Superintendent of Motive Power, Union Station, Pittsburgh, Pa., in 1907. He was President of the Shop Foremen's Association of the Pittsburgh Division, and a member of the Veteran's Association.

He was an active and consistent member of the Calvary Lutheran Church of Wilkinsburg, and by his upright life set a noble example to his fellows.

He became a member of The Railway Club of Pittsburgh on September 23rd, 1904, and as a member has always been both active and helpful. His sterling integrity and cheerful disposition made him an esteemed friend of all his associates. His long years of experience and good sound judgment enabled him to add materially to the value of the papers and discussions presented before this Club; and his never-ending fund of humor shed brightness on many an otherwise dry and technical discussion. In his death this Club has suffered the loss of a member whose place will not soon be filled.

The Committee would ask that a copy of this paper be forwarded to the family of Mr. Krause.

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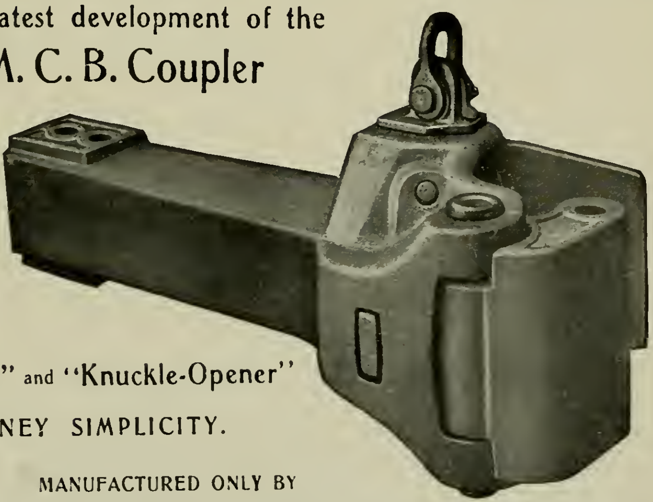

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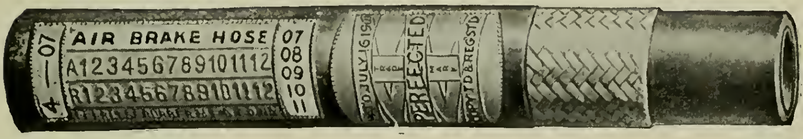

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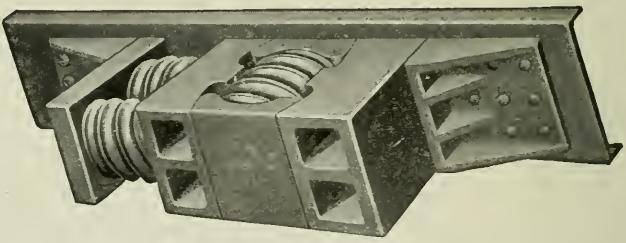

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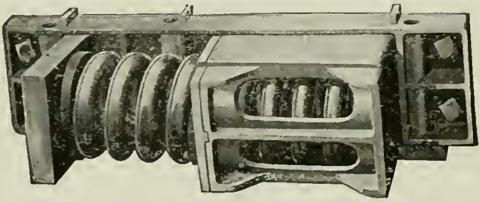

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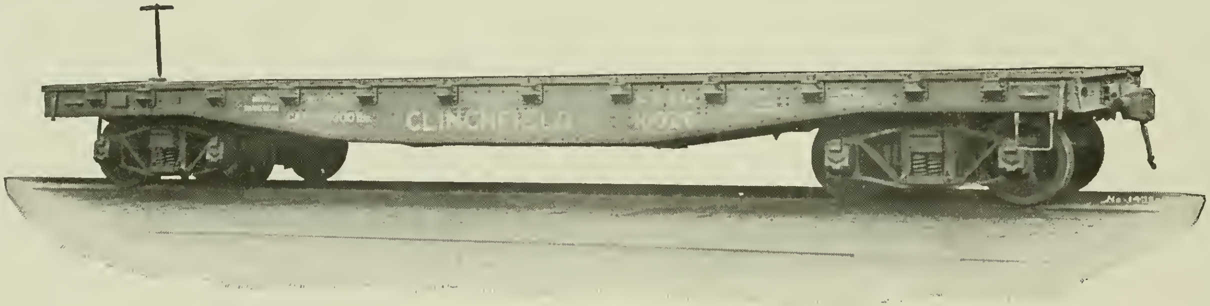

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